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ORIGINAL ARTICLE

The influence of preoperative opioid use on inpatient opioid requirements and discharge prescriptions after primary shoulder arthroplasty

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Background: Active opioid users experience more pain and require more opioids after primary shoulder arthroplasty than non-opioid users. However, it is unknown whether discharge prescription regimens are tailored to these different postoperative opioid requirements.

Methods: We performed a retrospective analysis of a prospectively collected cohort of patients who underwent primary shoulder replacement over a 15-month period. Demographic and operative variables were collected and compared between prior opioid users and non-opioid users. Inpatient opioid requirements, daily discharge prescription regimens, total prescription quantities, and rates of persistent opioid use 6 weeks after surgery were also compared between these cohorts.

Results: A total of 119 patients were analyzed (mean age, 68 years; 53% men; 39.5% prior opioid users). Prior opioid users required considerably more opioids on the first (60 oral morphine equivalents [OMEs] vs 45 OMEs, $P = .01$) and last (42 OMEs vs 15 OMEs, $P < .001$) hospitalization days but were discharged with similar daily opioid regimens (90 OMEs vs 90 OMEs, $P = .3$), total opioid quantities (600 OMEs vs 600 OMEs, $P = .24$), and total pills (80 vs 60, $P = .27$) compared with non-opioid users. Persistent opioid use 6 weeks after surgery was 7-fold higher for prior opioid users than nonusers (71.0% vs 9.1%, $P < .001$).

Conclusions: Daily and total opioid regimens prescribed after primary shoulder arthroplasty were similar between prior opioid users and nonusers despite large differences in their inpatient opioid requirements. Tailoring discharge opioid prescription regimens to inpatient use appears feasible and warrants further study.

Level of evidence: Level II; Retrospective Design; Prognosis Study

Keywords: Opioid epidemic; shoulder arthroplasty; opioid prescription; orthopedic surgery; pain management; discharge prescription

The United States is currently in an opioid crisis, consuming over 80% of the world's opioid supply while comprising only 4.6% of its population.[19] Although the origins of this crisis are multifactorial, excessive postsurgical opioid prescriptions are considered a major contributor. Patients

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undergoing procedures in various surgical disciplines have been found to have large quantities of pills remaining after their surgical pain subsides,[3-5,15,17,31] and these unused pills have been shown to be a major source for opioid misuse in the community.[14] Efforts are thus being directed to establish effective postoperative opioid regimens that control pain while minimizing the risk of pill diversion.[21]

Determining safe and effective opioid regimens can be particularly difficult for patients who take opioids preoperatively, considering the tolerance and habituation that develop with use of these medications. Consumption of opioids can invoke changes to the nervous system after just 1 month of use,[9] including μ-opioid receptor upregulation and activation of neuroexcitatory mechanisms that can result in opioid tolerance and general hyperalgesia.[26] Such tolerance poses considerable challenges for adequate pain control after orthopedic procedures, as opioids remain the treatment of choice in this setting considering their convenience and effectiveness in reducing surgical pain.[28] In particular, patients using opioids for pain control prior to hip and knee arthroplasty experience more postoperative pain, require more postoperative opioids, and have higher 90-day complication rates than non-opioid users.[29] Similarly, opioid users undergoing either anatomic total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (rTSA) experience higher pain levels and consume more opioids postoperatively than non-opioid users.[8,20] As such, while other medications may alter postoperative pain levels, preoperative opioid use has been repeatedly associated with a substantial increase in postoperative pain and opioid consumption.[8,20,29]

Despite evidence that non-opioid users require significantly fewer opioids after primary shoulder arthroplasty than active opioid users, it remains unclear whether discharge prescriptions are appropriately reduced for this population. Surgeons tend to avoid variation in discharge prescription regimens as doing so can be cumbersome, especially when electronic medical systems automate the generation of discharge prescription quantities.[1] However, when standard prescription quantities are provided to patients undergoing outpatient shoulder procedures, actual pill consumption has been found to vary with the type of procedure performed, resulting in variable quantities of unused pills that can risk diversion and misuse.[17] Thus, characterizing current prescription practices and defining patient factors that drive postoperative opioid consumption are warranted to establish effective prescription regimens, especially in the setting of primary shoulder arthroplasty where regimens vary considerably across institutions.[31]

The purposes of this study were to quantify inpatient opioid consumption and discharge opioid prescriptions at a single high-volume tertiary-care institution for patients undergoing primary shoulder arthroplasty and to assess whether prescription regimens are tailored to the different opioid requirements observed between opioid users and nonusers. We hypothesized that opioid regimens prescribed at discharge would closely match inpatient requirements for opioid users but would far exceed inpatient requirements for non-opioid users, demonstrating a need to better target opioid prescription regimens in this population.

Materials and methods

Patient cohort

In this retrospective cohort study, we performed a retrospective analysis of a prospectively collected clinical database from a single tertiary referral center over a 15-month period from July 1, 2016, to September 30, 2017. Patients were included if they were aged 18 years or older and underwent either primary TSA or rTSA. The exclusion criteria included transfer to a non-orthopedic surgery service prior to discharge, revision shoulder replacement, and outpatient surgery.

Demographic data

Demographic variables including patient age, sex, and body mass index (BMI) were collected along with active preoperative opioid use (defined as having an opioid on the patient's admission medication reconciliation) or depression diagnosis by identification of *International Classification of Diseases, Tenth Revision* diagnosis codes F33.9, F33.0, F33.1, F33.2, F33.3, F33.41, F33.42, F32.8, or F32.9 on the patient's admission problem list. Depression was included for comparison as this diagnosis has been consistently shown to be associated with higher opioid requirements and consumption.[30]

Surgical and inpatient data

Surgical and inpatient factors including operative time, length of hospitalization, replacement type (rTSA or TSA), and American Society of Anesthesiologists (ASA) score were collected. Three fellowship-trained surgeons (B.T.F., C.B.M., and A.L.Z.) performed all procedures, and all procedures were performed with the patient in the semi–beach-chair position after administration of regional anesthesia (interscalene block) and induction of general anesthesia. A deltopectoral skin incision and approach were used in all patients. Indications for surgery included osteoarthritis, avascular necrosis, proximal humeral fracture, and rotator cuff arthropathy. The decision to perform rTSA versus TSA was made at the attending surgeon's discretion, but generally, rTSA was chosen for patients with an incompetent rotator cuff and TSA was chosen for patients with a competent rotator cuff.

Opioid conversion

The dose, type, and quantity of opioid pills prescribed at discharge were obtained and converted into total oral morphine equivalents (OMEs), or the equivalent milligrams of oral morphine, using the institution's standard opioid conversion tables. Converting all prescription quantities into OMEs, which is the common metric used in opioid utilization studies, makes comparison and interpretation of opioid quantities possible.[23] If patients were prescribed multiple opioids at discharge, each total prescription was converted into OMEs; these values were then added together to create a single total OME amount prescribed for each patient. The