



## Outpatient narcotic consumption following total shoulder arthroplasty



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**Introduction:** In the setting of the opioid epidemic, physicians continue to scrutinize ways to minimize exposure to narcotic medications. Several studies emphasize improvements in perioperative pain management following total shoulder arthroplasty (TSA). However, there is a paucity of literature describing outpatient narcotic consumption requirements following TSA.

**Methods:** A single-institution, prospective study of patients undergoing primary TSA was performed. Preoperative demographics including exposure to narcotics, smoking history, and alcohol exposure were collected. The primary outcome was measurement of total outpatient narcotic consumption 6 weeks from surgery. Narcotic consumption was verified by counting leftover pills at the final follow-up visit.

**Results:** Overall, 50 patients were enrolled. The median narcotic consumption in the cohort was 193 morphine equivalent units (MEUs), approximately 25 (5-mg) tablets of oxycodone, and the mean consumption was 246 MEUs, approximately 32 (5-mg) tablets. Almost 25% of patients consumed fewer than 10 total tablets, with 10% of patients taking no narcotics at home. Multivariate regression found preoperative narcotic exposure associated with increased consumption of 31 MEUs ( $P = .004$ ). Older age was found to be protective of narcotic consumption, with increasing age by 1 year associated with 0.75 MEU decrease in consumption ( $P = .04$ ).

**Conclusions:** Anatomic total shoulder arthroplasty in general provides quick, reliable pain relief and does not require a significant amount of narcotic medication postoperatively. For most patients, it is reasonable to prescribe the equivalent of 25–30 (5-mg) oxycodone tablets following TSA.

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The opioid epidemic continues to be a major public health crisis in the United States.<sup>6,8,13</sup> The explosion of narcotic prescriptions for both acute and chronic pain and the associated increase of narcotic abuse and overdose problems is well documented. Narcotic medications continue to be the central modality to most postoperative pain control regimens.<sup>5,8,9,13,15</sup> Recently, orthopedic surgeons have investigated methods to minimize narcotic exposure in the perioperative period through multimodal pain management pathways.<sup>12,17,21</sup> Total shoulder arthroplasty is well known to provide patients with quick, reliable, and effective pain relief following surgery<sup>5,12,17</sup>; however, like any surgical procedure, the management of perioperative pain is an important aspect of patient care, and the typical need for perioperative narcotic use is ill-defined.

Despite the rising attention to pain management and narcotic use, there are limited data to support how much opioid medication should be prescribed following specific orthopedic procedures. Studies in upper extremity surgery are limited to nonarthroplasty procedures in the hand.<sup>9,18</sup> Most studies investigating this question find that preoperative narcotic use is associated with prolonged narcotic use postoperatively.<sup>2,4,5,15,18,21,23</sup> Several of these studies use insurance databases that are limited in understanding the quantity of medication that patients consume following surgery. Additionally, there is little granularity in terms of patient-related factors that may lead to increased or prolonged narcotic consumption.

Excessive prescriptions and unused pills place friends and family members at risk.<sup>3,11</sup> The majority of narcotic abuse results from diversion of a prescription that was appropriately obtained. The purpose of this study was to gain a better understanding of outpatient consumption patterns in terms of total narcotic consumed, length of consumption following surgery, and attempt to understand patient factors that may lead to increased outpatient

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usage following a surgery with known reliable pain relief. The goal is to provide surgeons with a reasonable framework of how much narcotic is reasonable to prescribe following TSA.

## Methods

We performed a prospective cohort study of adult patients undergoing TSA at a single institution. Institutional review board approval was obtained. Patients were included in the study if they were indicated by one of 3 fellowship-trained shoulder and elbow surgeons for primary TSA for the diagnosis of primary glenohumeral osteoarthritis. Exclusion criteria included patients undergoing reverse shoulder arthroplasty, revision arthroplasty, or prior shoulder surgery (either open or arthroscopic), or arthroplasty performed for a diagnosis other than osteoarthritis. Subjects were also excluded if they could not receive an interscalene block with catheter preoperatively, which is the standard of care for adjunctive perioperative pain control at our institution. Subjects were consented to participation at the time of preoperative evaluation and told the purpose of the study was to track the amount of pain medication they required following TSA. There was no attempt to modify the amount of pain medication the patient consumed following surgery. Subjects were instructed to take the pain medication simply as needed for pain control.

Basic demographics including patient age, sex, diagnosis, and smoking status was obtained. Additionally, subjects were asked if they took narcotics preoperatively, the number of pills taken on average per week and for what diagnosis they were taking narcotics, with specific questioning regarding the need for medication in the surgical shoulder preoperatively. Patients were asked about why they were undergoing TSA. They also filled out the Brief Resiliency Scale and the Michigan Alcohol Screening Test preoperatively to determine if there was any association with subject behavior and postoperative narcotic consumption. During the perioperative period, length of stay in the hospital was recorded. Preoperative visual analog scale pain scores were assessed.

All subjects received an interscalene blockade with a catheter placed in the preoperative holding area by trained regional anesthesiologists. The regional anesthetic was designed to provide a continuous local anesthetic blockade for a duration of 48–72 hours. Subjects underwent TSA with a general anesthesia and no other supplementary local anesthetic. Postoperatively, subjects received the scheduled 1000 mg of acetaminophen every 6 hours, 5 mg oxycodone scheduled every 4 hours, with an additional 5 mg available every 4 hours as needed. Interscalene catheters were removed on postoperative day 3 per our standard protocol. At the time of discharge, subjects were prescribed 60 tablets of 5-mg oxycodone as well as 60 tablets of 500-mg acetaminophen. If subjects did not tolerate this pain regimen, substitutes for other narcotic pain medicines were made accordingly.

To accurately track the number of narcotics consumed at home postoperatively, subjects were contacted by e-mail daily for the first 2 weeks after surgery and asked how many pills they consumed and if they discontinued the use of narcotics. They continued to receive weekly e-mails from 2–6 weeks postoperatively. Additionally, subjects were asked to bring their narcotic pills to their 2- and 6-week follow-up visits in order for pills to be counted by a member of the research team to verify the number of pills consumed. Refills were also tracked. At final follow-up (6 weeks), subjects were asked to rate their pain as well as satisfaction with pain management. They were also asked why they stopped narcotics if they did. Finally, if subjects received narcotic medications from another source during the study period, they were excluded from the study.

The primary outcome for this study was total outpatient narcotic consumption following hospital discharge in morphine equivalent units (MEUs) at the 6-week postoperative follow-up. This time point was chosen because of the reliable pain relief following TSA.<sup>5</sup> Additional secondary outcomes included the number of subjects who discontinued narcotics before the 2- and 6-week postoperative follow-up visits, respectively, as well as overall satisfaction with pain management. No power analysis was performed as this was a pilot study aimed to gather baseline information.

Statistical analysis was performed to determine if any participant-related factors were associated with increased opioid consumption postoperatively. Total morphine equivalents consumed was statistically modeled as an additive linear function of the available preoperative predictor variables, and a multivariate model was run using a fixed effects model to determine if any predictor variable was significantly associated with increased consumption. Categorical variables were tested using Pearson  $\chi^2$  or Fisher exact test, and continuous variables were tested using the Kruskal-Wallis rank-sum test (nonparametric 1-way analysis of variance). The multivariate models were sequentially reduced by removal of nonsignificant effects until only significant effects remained. All tests were performed using SAS, version 9.4 (SAS Institute, Inc, Cary NC, USA).

## Results

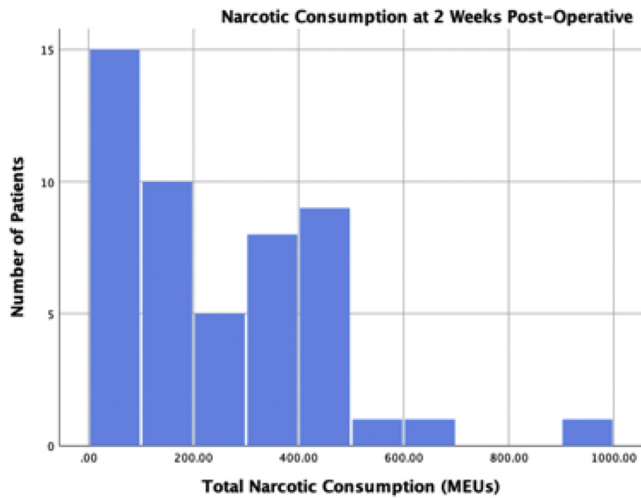
Table 1 demonstrates the demographic information and preoperative variables of the participants. Overall, 50 of 54 subjects enrolled were eligible for inclusion in this prospective cohort study with complete data at 6 weeks. One subject received narcotics from another provider during the study period and was excluded. The remaining 3 excluded subjects did not provide their narcotics pills for verification of consumption. In total, 12 of 50 subjects (24%) took narcotics preoperatively. All 12 subjects reported that their shoulder pain was the reason for consuming narcotic medication. Of these 12 subjects, 6 admitted to consuming >20 pills per week. The average length of stay was 1.2 days, with 40 of 50 patients staying only 1 night.

Figures 1 and 2 demonstrate the distribution of opioid consumption at both 2 and 6 weeks following TSA. As the figure shows, the distribution of consumption was not normally

**Table 1**  
Demographics

Age, yr, mean (range)	63.7 (35–81)
Sex, male, n/N (%)	25/50 (50)
Preoperative narcotic consumption per week, n (%)	
Never	38 (76)
0–10 pills	6 (12)
20–40 pills	5 (10)
>40 pills	1 (2)
Preoperative length of narcotic consumption, n (%)	
3–6 mo	1 (8.3)
>6 mo	11 (91.7)
Shoulder main source for narcotic medication, n (%)	12 (100)
Smoking status, n (%)	
Never	31 (62)
Former	15 (30)
Current	4 (8)
MAST score, mean $\pm$ SD	8.2 $\pm$ 3.6
BRS score, mean $\pm$ SD	4.0 $\pm$ 0.6
VAS score, mean $\pm$ SD	61.5 $\pm$ 19.7
Length of stay, d, mean $\pm$ SD	1.2 $\pm$ 0.6
Disposition home, n (%)	49 (98)

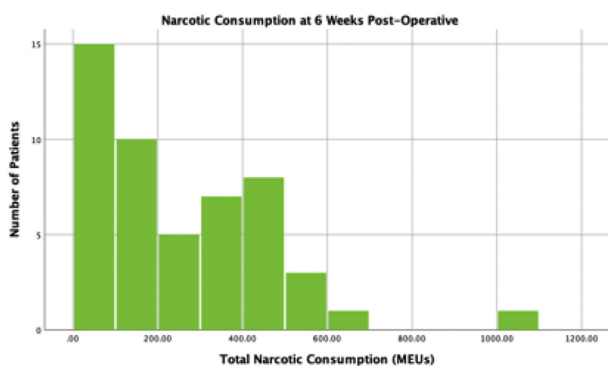
MAST, Michigan Alcohol Screening Test; SD, standard deviation; BRS, Brief Resiliency Scale; VAS, visual analog scale.



**Figure 1** Distribution of total narcotic consumption at 2 weeks postoperation. MEUs, morphine equivalent units.

distributed, with right-skew. Median consumption through 2 weeks was 191.3 MEUs (range 0–900), the equivalent of 25 oxycodone (5-mg) tablets. The median consumption through 6 weeks was similar at 193.0 MEUs (range 0–1028.5). In the entire cohort, 5 subjects did not consume any narcotic medication at all. Almost 25% (13/50) of subjects consumed the equivalent of 10 or fewer 5-mg oxycodone tablets.

Approximately half of the subjects (26/50) reported discontinuation of all opioid medication by the 2-week follow-up visit. At the time of final follow-up, 43 of 50 subjects reported discontinuation of these medications. Between weeks 2 and 3, 12 more patients self-reported stopping opioid medication. Additionally, 2 patients self-reported discontinuation between weeks 3 and 4, and 3 more patients stopped between weeks 4 and 5. **Table II** demonstrates the postoperative visual analog scale pain score and satisfaction with pain management. Overall, the cohort experienced a clinically relevant and statistically significant mean decrease in visual analog scale pain score of 45.5 points ( $P < .001$ , 95% confidence interval: 38.9–52.0). Additionally, the majority of subjects were found to be very satisfied with pain management. There was no correlation with either the Brief Resiliency Scale score ( $P = .95$ ) or the Michigan Alcohol Screening Test score ( $P = .81$ ) with narcotic consumption in this cohort.



**Figure 2** Distribution of total narcotic consumption at 6 weeks postoperation. MEUs, morphine equivalent units.

**Table II**

Postoperative pain assessment

Postoperative VAS score, mean $\pm$ SD	17.8 $\pm$ 14.0
Satisfaction with pain management, n (%)	
Very dissatisfied	0 (0)
Somewhat dissatisfied	2 (4)
Neither	1 (2)
Somewhat satisfied	4 (8)
Very satisfied	43 (86)
Continued narcotic consumption past 6 wk	7 (14)

VAS, visual analog scale; SD, standard deviation.

Finally, multivariate fixed effects models were run for total narcotic consumption at 2 and 6 weeks, respectively. Patient-related variables input into the model included age, sex, smoking status, amount of preoperative narcotic consumption, length of stay, pre- and postoperative pain scores, satisfaction with pain management, and reasons for stopping narcotics. Variables were removed until only significant variables were included. **Tables III** and **IV** demonstrate the results of these models.

At 2-week follow-up, both former and current smoking status were significantly associated with increased consumption. Subject age did not correlate with narcotic consumption at 2 weeks ( $P = .51$ ). Current smokers consumed 211.6 more MEUs of opioids compared with nonsmokers ( $P = .03$ ). Former smokers consumed 110.9 MEUs more than nonsmokers ( $P = .03$ ). Preoperative narcotic use of 20–40 pills per week was also associated with increased consumption, as these subjects consumed 238.1 more MEUs than narcotic-naïve subjects ( $P = .006$ ). Interestingly, subjects who stated they stopped taking narcotics because of the fear of addiction took on average 319.2 MEUs less than those who did not state this ( $P = .003$ ).

At 6 weeks of follow-up, the model found only age and preoperative narcotic consumption to be of significance. Increasing age by 1 year was associated with decreased consumption of 0.75 MEUs ( $P = .05$ ). Once again, preoperative narcotic consumption of 20–40 pills per week was associated with 31.8-MEU increase in consumption at 6 weeks of follow-up ( $P = .004$ ). Smoking status was found to be significantly associated in this model.

## Discussion

Anatomic total shoulder arthroplasty provides patients overall good outcomes with generally reliable pain relief. Our study's purpose was to better quantify the amount of opioid medication that patients typically consume following hospital discharge after TSA. Most patients consumed less than the equivalent of 25 oxycodone (5-mg) pills, with more than half of patients stopping

**Table III**

Multivariate model at 2 weeks postoperative

Variable	Estimate	Standard error	<i>P</i> value
Intercept	74.6	124.4	.6
Smoking status			
Current	<b>211.6</b>	<b>92.3</b>	<b>.03</b>
Former	<b>110.9</b>	<b>50.2</b>	<b>.03</b>
Never	0		
Number of pills consumed preoperation			
None	0		
0–10	–87.1	75.4	.25
20–40	<b>238.1</b>	<b>83.6</b>	<b>.006</b>
>40	227	195.7	.25
Scared of addiction?			
Yes	<b>–319.2</b>	<b>102.6</b>	<b>.003</b>
No	0		

Boldface indicates significance.

**Table IV**  
Multivariate model at 6 weeks postoperative

Variable	Estimate	Standard error	P value
Intercept	58.2	24.3	.02
Age	<b>−0.75</b>	<b>0.37</b>	<b>.05</b>
Number of pills consumed preoperation			
None	0		
0–10	−7.71	9.46	.41
20–40	<b>31.78</b>	<b>10.5</b>	<b>.004</b>
>40	4.8	22.2	.83

Boldface indicates significance.

opioid consumption by 2 weeks of follow-up. Elderly patients consumed less than younger patients, and preoperative narcotic consumption, even for shoulder pain, was associated with increased total consumption. The findings of this study allow surgeons to provide patients with a reasonable expectation and framework of how much narcotic medication is typically needed following TSA.

The opioid epidemic is well-documented and represents a major US public health crisis.<sup>3,6,13,20</sup> One of the major contributing factors to the epidemic is overprescribing of opioid medications by medical providers.<sup>11,16</sup> Orthopedic surgeons remain one of the largest prescribers of opioid medications by specialty as these are central to most postoperative pain regimens.<sup>5,12</sup> Despite several studies documenting that prescription medications are frequently the root cause of later abuse and overuse, there is very little guidance for orthopedic surgeons regarding reasonable prescription medication recommendations. Recent studies investigating prescribing habits following outpatient surgery found up to 67%–71% of opioid pain pills prescribed are never used by patients.<sup>7,18</sup> The findings of our study provide reasonable expectations for how much narcotic medication patients should receive following TSA and can help prevent overprescribing. At our institution, the findings from this study resulted in a decrease of outpatient narcotic prescription quantity by 33%.

Specific studies investigating opioid consumption and TSA mostly focus on inpatient consumption with strategies to attempt to decrease exposure immediately postoperatively.<sup>2,4,5,15,17</sup> The majority of these studies found that preoperative narcotic exposure was associated with increased inpatient demands of narcotics. Additional risk factors included smoking and history of psychiatric disorders.<sup>5,10,15,17,19</sup> Unlike lower extremity arthroplasty, preoperative narcotic consumption does not seem to be associated with higher incidence of short-term postoperative complications.<sup>4</sup> The findings from our study are in alignment with these prior studies, as the biggest risk factors for increased consumption at early follow-up were smoking and prior narcotic use.

Strategies to decrease narcotic consumption following surgery include use of several multimodal pathways, including regional and local anesthetic blocks, preoperative patient education, cryotherapy, and use of non-narcotic adjuvant medications.<sup>1,2,5,14,17,21,22</sup> The majority of these studies examine narcotic consumption in the immediate postoperative period during hospital admission. Nicholson et al<sup>17</sup> investigated the efficacy of adjuvant use of acetaminophen, pregabalin, and celecoxib for patients undergoing shoulder arthroplasty. The medicines were given 2 hours preoperatively and scheduled for 24 hours postoperatively. Similar adjuvant medication strategies have been used in other surgeries.<sup>1,14,16</sup> All patients received a single-shot interscalene brachial plexus blockade to help with perioperative pain management. Interestingly, they found that the adjuvant group required more narcotics in the first 24 hours following surgery but had better subjective pain scores compared with a group of patients only using narcotic medications. Despite better pain scores in the adjuvant

treatment group, the study did not determine if adjuvant treatment affected patients' narcotic consumption following discharge in the subacute perioperative period.

Given the pain relief that TSA can provide for patients in a relatively short time following surgery, investigation into opioid-free pain management pathways are intriguing. Leas et al<sup>12</sup> recently published a pilot program for opioid-free pain management for a group of patients undergoing shoulder arthroplasty. The group consisted of opioid-naïve patients undergoing primary elective shoulder arthroplasty. Patients received a comprehensive perioperative multimodal pain management strategy including scheduled acetaminophen, ketorolac, gabapentin coupled with an interscalene block, and aggressive cryotherapy. Overall, they found high satisfaction of pain management, and only 2 of 35 patients requiring narcotics in the postoperative period. The data from our study suggest that a small percentage of patients do not require narcotics in the immediate discharge to home postoperative period following TSA when an interscalene catheter is used. Additionally, narcotic consumption typically decreases rapidly, such that more than half of patients discontinue opioids within 2 weeks. Implementing an opioid-free pain management pathway requires significant preoperative education and “buy-in” from both patients and physicians, as opioid medications are generally expected by the patient following most surgical procedures.<sup>5,22</sup>

There are several limitations to our study. The study was limited to a small number of patients to understand typical narcotic consumption patterns. This study was likely underpowered to determine if preoperative psychologic factors such as resiliency or addictive behaviors were associated with postoperative narcotic consumption. The study was limited to anatomic total shoulder arthroplasty, not reverse shoulder arthroplasty, so the findings cannot be extrapolated for all primary shoulder arthroplasty patients. Further investigation is needed in the reverse shoulder arthroplasty population. There was a variable day of discharge for the subjects in this study, which may bias earlier discharge to home subjects to a greater narcotic usage. Narcotic consumption was only tracked for 6 weeks, but most patients had discontinued or returned to baseline consumption at this time point. We also did not investigate inpatient narcotic use, which is a limitation; however, the goal of this study was to examine postoperative narcotic consumption. The use of a prolonged interscalene regional anesthetic likely decreased early narcotic consumption, thereby limiting the generalizability of the current study findings to patients who did not have a regional anesthetic. Additionally, we did not evaluate the efficacy of the block, which could lead to variable pain relief. Finally, patients were aware of the goal of the study and may have stopped earlier than they would have otherwise.

## Conclusions

Anatomic total shoulder arthroplasty provides reliable pain relief for a variety of patients. For most opioid-naïve patients, it is reasonable to prescribe the equivalent of 30 (5-mg) oxycodone tablets following TSA. Several patients in our study demonstrated no narcotic requirements. This study serves as a baseline for further investigation of methods to decrease postoperative narcotic consumption in higher-risk patients and the efficacy of adjunctive treatments in managing postoperative pain.

## Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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