

# Risk Factors for Preoperative Opioid Use in Patients Undergoing Primary Anatomic Total Shoulder Arthroplasty

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## abstract

The effect of preoperative opioid use in orthopedic patients has been highlighted. Numerous studies have identified worse patient outcomes with preoperative opioid use; however, there is currently no information identifying risk factors for preoperative opioid use in the total shoulder arthroplasty (TSA) population. The purpose of this study was to determine risk factors for preoperative opioid use in patients undergoing primary anatomic TSA for primary osteoarthritis (OA) and to determine baseline preoperative patient-reported outcomes (PROs) in preoperative opioid users compared with nonopioid users. The authors studied 982 TSAs performed for primary glenohumeral joint OA in a prospective TSA registry. Patient demographic and clinical characteristics were prospectively assessed and included age; sex; socioeconomic status (SES); smoking status; body mass index (BMI); and history of chronic back pain, depression, diabetes mellitus, and heart disease. Preoperative PROs, range of motion measurements, and preoperative opioid use for shoulder pain were assessed. Overall, 254 (25.9%) of 982 total patients were taking preoperative opioids for shoulder pain in the setting of primary OA. Female sex ( $P=.023$ ), younger age ( $P=.019$ ), obesity (BMI  $>30$  kg/m<sup>2</sup>) ( $P=.043$ ), chronic back pain ( $P<.001$ ), and lower SES ( $P=.002$ ) were associated with increased preoperative opioid use following multivariate logistic regression. Patients with opioid use had significantly worse preoperative pain scores ( $P<.001$ ), American Shoulder and Elbow Surgeons scores ( $P<.001$ ), and total Constant scores ( $P<.002$ ) compared with the non-opioid group. [*Orthopedics*. 2020;43(6):356-360.]

The opioid epidemic has had a significant impact on orthopedic surgery.<sup>1</sup> Preoperative opioid use has been associated with postoperative physician shopping<sup>2</sup> and worse outcomes following orthopedic surgeries, including anatomic total shoulder arthroplasty (TSA),<sup>3</sup> reverse TSA,<sup>4</sup> and arthroscopic

rotator cuff repair,<sup>5</sup> among others.<sup>6-8</sup> However, there is currently no information of which the authors are aware identifying the potential risk factors for preoperative opioid use in the TSA population.

Determining risk factors for preoperative opioid use in this population is of interest for multiple reasons. First, it

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is widely reported that patients with preoperative opioid use can demonstrate worse postoperative outcomes<sup>3,4,6-8</sup>; thus, identifying modifiable risk factors associated with preoperative opioid could help improve postoperative outcomes. It is also possible that patients with a history of depression or chronic pain may demonstrate higher preoperative opioid use and may benefit from a multidisciplinary approach to address these conditions in addition to addressing the shoulder pathology. In addition, there may be poorly understood variables, like access to care for the treatment of shoulder osteoarthritis (OA) based on socioeconomic status (SES). Patients of lower SES may have limited access to care and may potentially present with worse function, more pain, and higher preoperative opioid use than patients of higher SES.

The purpose of this study was to determine risk factors for preoperative opioid use in patients undergoing primary anatomic TSA for primary OA and to determine preoperative patient-reported outcomes (PROs) in preoperative opioid users compared with nonopioid users. The authors' primary hypothesis was that risk factors for preoperative opioid would include lower SES, chronic back pain, smoking history, and depression. Their secondary hypothesis was that patients with preoperative opioid use would have worse preoperative pain scores, worse American Shoulder and Elbow Surgeons (ASES) scores, and worse Constant scores.

## MATERIALS AND METHODS

### Patient Inclusion Criteria and Demographics

The authors studied 982 eligible patients in a prospective TSA registry who underwent primary anatomic TSA for the treatment of primary glenohumeral OA. All of the patients were enrolled in the registry at a single, high-volume TSA center by the senior author (T.B.E.) prior to surgery.

Patient demographic and clinical characteristics were prospectively assessed and included age; sex; smoking status; body mass index (BMI); and history of chronic back pain, depression, diabetes mellitus, and heart disease. Preoperative opioid use was determined prospectively by asking: "Do you take narcotic pain medication (codeine or stronger) for your shoulder—yes or no?"<sup>9,10</sup>

Constant score,<sup>11</sup> ASES score,<sup>10</sup> Single Assessment Numeric Evaluation (SANE),<sup>12</sup> and range of motion (ROM) measurements were assessed preoperatively for all patients. The Area Disability Index (ADI) was used to determine SES. The ADI is a relatively new database that can quantify SES by using neighborhood housing quality, education, employment, and domains of income data.<sup>13</sup> The ADI provides a more comprehensive and faceted view of SES compared with insurance category alone. The ADI was obtained for each patient by placing the patient's address into an online database ([www.neighborhoodatlas.medicine.wisc.edu](http://www.neighborhoodatlas.medicine.wisc.edu)).

### Clinical Assessment

The senior author (T.B.E.) performed all examinations in a standardized fashion.<sup>14</sup> Range of motion measurements were determined using a goniometer. Strength of abduction was measured using a handheld digital dynamometer (Chatillon Digital Force Gauge 90.72 kilogram-force; AMETEK, Inc, Largo, Florida).

### Statistical Analysis

The prevalence of opioid use prior to TSA was calculated, and then patients were grouped for analysis according to their preoperative opioid use status. Chi-square tests were performed to determine whether significant differences existed between opioid use groups for baseline patient characteristics such as sex; age at surgery; BMI; ADI; smoking status; and history of chronic back pain, depression, diabetes mellitus, or heart disease. Preoperative pain and function measures were

evaluated with Student *t* tests to determine significant differences between opioid use groups. Multivariate, logistic regression was used to identify risk factors of preoperative opioid from baseline patient characteristics. Statistical analyses were performed with Stata release 15 (StataCorp LLC, College Station, Texas), and all differences were considered statistically significant if  $P < .05$ .

## RESULTS

Of the 982 patients who underwent primary anatomic TSA for the treatment of primary glenohumeral arthritis, 254 (25.9%) were taking opioid medications preoperatively for their shoulder pain (**Table 1**). A significantly higher number of opioid users were female (45.3%), whereas the non-opioid group was 35.9% female ( $P = .008$ ). Additionally, patients who were obese (BMI  $> 30$  kg/m<sup>2</sup>) had significantly higher opioid use as compared with normal-weight (BMI  $\geq 25$  kg/m<sup>2</sup>) patients ( $P = .004$ ). Patients taking preoperative opioids also reported a higher rate of chronic back pain (45.7% vs 30.4%,  $P < .001$ ), depression (16.5% vs 9.6%,  $P = .003$ ), and diabetes mellitus (16.5% vs 11.4%,  $P = .035$ ) than the non-opioid group. Patients with a lower SES as demonstrated by ADI in the most disadvantaged or second quartiles took opioids at a higher rate than both the third and least disadvantaged quartiles (all  $P \leq .01$ ). There was no difference in opioid use in patients presenting for their dominant shoulder, current smokers, or those with a history of heart disease (all  $P > .05$ ).

Preoperative pain and function measures were significantly different between opioid use groups (**Table 2**). Patients using opioids reported worse preoperative Constant pain scores than the non-opioid group (2.8 ± 2.5 vs 4.0 ± 3.0,  $P < .001$ ). Activities of daily living were significantly more difficult for the patients taking opioids (6.4 ± 3.7 vs 7.7 ± 3.9,  $P < .001$ ); however, no significant differences were noted in the Constant mobility and strength measures ( $P > .05$ ). The total Constant and

Table 1

Patient Characteristics According to Preoperative Opioid Use

Characteristic	Opioid Use		P
	No (n=728; 74.1%)	Yes (n=254; 25.9%)	
Sex, No.			.008
Female	261 (35.9%)	115 (45.3%)	
Male	467 (64.1%)	139 (54.7%)	
Age at surgery, mean±SD, y	67.1±9.6	65.7±10.1	.048
BMI, No.			<.001
Normal weight (<25 kg/m <sup>2</sup> )	116 (16.2%)	29 (11.4%)	
Overweight (25-30 kg/m <sup>2</sup> )	318 (44.4%)	89 (35.0%)	
Obese (>30 kg/m <sup>2</sup> )	283 (39.5%)	136 (53.5%) <sup>a</sup>	
Dominant shoulder, No.	359 (49.3%)	120 (47.2%)	.570
Current smoker, No.	27 (3.8%)	12 (4.7%)	.512
Chronic back pain, No.	221 (30.4%)	116 (45.7%)	<.001
Depression, No.	70 (9.6%)	42 (16.5%)	.003
Diabetes mellitus, No.	83 (11.4%)	42 (16.5%)	.035
Heart disease, No.	63 (8.7%)	29 (11.4%)	.193
ADI by quartile, No.			.002
Most disadvantaged	171 (23.5%)	78 (30.7%) <sup>b</sup>	
Second quartile	164 (22.5%)	74 (29.1%) <sup>b</sup>	
Third quartile	199 (27.3%)	49 (19.3%)	
Least disadvantaged	194 (26.6%)	53 (20.9%)	

Abbreviations: ADI, Area Disability Index; BMI, body mass index.

<sup>a</sup>Significantly more opioid use in obese patients as compared with normal-weight patients (P=.004).

<sup>b</sup>Significantly more opioid use in the most disadvantaged and second quartiles as compared with both the third and least disadvantaged quartiles (all P≤.01).

adjusted Constant scores were significantly lower in the opioid group (P=.002 and P=.001, respectively). Patient pain measured on the ASES scale was also significantly higher in the opioid group (6.6±2.6) as compared with the non-opioid group (5.6±2.7, P<.001). In addition, total ASES score was significantly lower in the opioid group (30.6±18.9) than the non-opioid group (38.4±18.4, P<.001).

A multivariate logistic regression model was created with all significant patient characteristics entered into the model to identify the risk factors for opioid use prior to TSA (Table 3). Factors significantly associated with increased preoperative opioid use included female

sex (risk ratio [RR]=1.30, P=.023), age in years (RR=0.98, P=.019), obesity (RR=1.44, P=.043), history of chronic back pain (RR=1.52, P<.001), and lower SES according to ADI (RR=1.41, P=.002). A history of depression or diabetes mellitus was not a significant risk factor for preoperative opioid use in this study population.

DISCUSSION

This investigation noted a high prevalence of preoperative opioid use in patients with shoulder pain in the setting of primary OA (25.9%). The authors' primary hypothesis was partially validated because risk factors for preoperative opioid use includ-

ed lower SES, chronic back pain, younger age, female sex, and obesity. Smoking history and history of depression were not found to be statistically significant risk factors for preoperative opioid use in this population. The authors' secondary hypothesis was validated in that patients with preoperative opioid use had worse preoperative pain scores, worse ASES scores, and worse Constant scores compared with patients without preoperative opioid use.

Preoperative opioid use has been associated with worse clinical outcomes after orthopedic surgeries,<sup>5,7,8</sup> and the current group was the first to demonstrate the effect of preoperative opioid use on outcomes following anatomic TSA and reverse TSA.<sup>3,4</sup> The prevalence of preoperative opioid use in the current primary glenohumeral OA population prior to TSA (254 of 982 patients, 25.9%) was similar to the recently reported prevalence in a population of patients prior to arthroscopic rotator cuff repair (44 of 200 patients, 22%)<sup>5</sup> and a large population of surgical patients (7894 of 34,186 patients, 23.1%).<sup>15</sup>

The risk factors for preoperative opioid use that the authors identified for primary OA patients presenting for TSA mirrors recent literature for other surgical populations. A recent study examining opioid use in all surgical patients also identified younger patient age to be a risk factor.<sup>15</sup> Additionally, opioid users prior to arthroscopic rotator cuff repair were more likely to be women and have higher rates of comorbidities, including back pain, depression, degenerative joint disease, and chronic pain.<sup>5</sup>

The authors are not aware of a specific physiological explanation for poorer outcomes in patients with preoperative opioid use; however, there appears to be a clear association with worse outcomes in patients with preoperative opioid use. There are some data to suggest the use of opioids preoperatively can contribute to opioid tolerance and worse outcomes.<sup>9,16,17</sup> Patient expectations and postoperative pain may more difficult to manage in pa-

tients who are being treated with opioids for shoulder arthritis prior to surgery, and this may negatively affect PROs postoperatively.

A potential application of the current investigation is preoperative opioid education, especially in the patients identified to be at-risk for preoperative opioid use. Education directed to primary care and referring providers may also be warranted to discuss the detrimental effect of opioids on TSA outcomes, along with strategies to treat symptoms of severe shoulder pain and OA in patients who initially prefer not to be referred for surgery.

The authors acknowledge that there are limitations of their investigation. The data were collected at a single center with a single surgeon and may be strengthened with a multicenter approach. The high-volume tertiary referral center is in a large metropolitan area and may not be reflective of the patient population in the community or in other regions of the United States. This study was not designed to assess postoperative follow-up data. It was designed to assess the time-zero population and determine the effect of the disease and other variables that may influence preoperative opioid use and preoperative pain and PROs.

This study had several strengths. First, it included a homogenous patient population, with all patients preparing to undergo anatomic TSA for primary OA. Second, the robust TSA registry allowed the authors to perform a multivariate linear regression and control for many variables that may influence preoperative pain and opioid use. Finally, this study represents one of the largest single-center cohorts for patients with primary shoulder OA undergoing anatomic TSA.

### CONCLUSION

There is a high prevalence of preoperative opioid use in patients with shoulder OA presenting for TSA (25.9%). Risk factors for preoperative opioid use included lower SES, younger age, female sex, chronic back pain, and obesity (BMI >30

Table 2

Preoperative Pain and Function Measures			
Measure	Opioid Use <sup>a</sup>		P
	No	Yes	
Constant score—pain	4.0±3.0	2.8±2.5	<.001
Constant score—activity	7.7±3.9	6.4±3.7	<.001
Constant score—mobility	10.7±8.0	10.0±7.9	.171
Constant score—strength	3.9±6.6	3.4±6.1	.317
Constant score—total	26.3±15.9	22.6±15.2	.002
Constant score—adjusted	33.7±19.8	29.1±18.6	.001
ASES score	38.4±18.4	30.6±18.9	<.001
ASES score—pain	5.6±2.7	6.6±2.6	<.001
SANE score	33.8±23.5	31.6±25.9	.211
Forward flexion	81.9°±36.8°	78.3°±36.2°	.206
External rotation	10.5°±14.3°	11.7°±13.9°	.249

*Abbreviations: ASES, American Shoulder and Elbow Surgeons; SANE, Single Assessment Numeric Evaluation.*  
<sup>a</sup>All values are mean±SD.

Table 3

Risk Factors for Preoperative Opioid Use From Multivariate Logistic Regression Analysis			
Risk Factor	Risk Ratio	95% CI	P
Female sex	1.30	1.04-1.61	.023
Age at surgery	0.98	0.97-0.99	.019
BMI			
Normal weight (≤25 kg/m <sup>2</sup> )	Reference	-	-
Overweight (25-30 kg/m <sup>2</sup> )	1.09	0.76-1.57	.641
Obese (>30 kg/m <sup>2</sup> )	1.44	1.01-2.05	.043
Chronic back pain	1.52	1.23-1.89	<.001
Depression	1.25	0.95-1.64	.118
Diabetes mellitus	1.15	0.88-1.51	.309
ADI			
Disadvantaged 50%	1.41	1.14-1.75	.002
Advantaged 50%	Reference	-	-

*Abbreviations: ADI, Area Disability Index; BMI, body mass index; CI, confidence interval.*

kg/m<sup>2</sup>). Patients with preoperative opioid use undergoing primary anatomic TSA for primary OA were found to have worse preoperative pain scores, worse ASES scores, and worse Constant scores compared with patients without preoperative opioid use.

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