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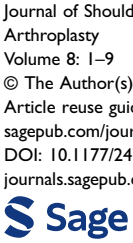

Greater Mental Health Burden is Associated With Poor Postoperative Pain Control and Increased Opioid Utilization Following Total Shoulder Arthroplasty

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Abstract

Background: Prolonged opioid use is associated with higher complications and worse patient-reported outcomes following total shoulder arthroplasty (TSA). Identified risk factors for prolonged postoperative use are related to several medical comorbidities, gender, diagnoses of anxiety or depressive disorders, and preoperative opioid use. In this study, we hypothesized that patient-reported mental health characteristics can help to identify patients at risk of worse postoperative pain control, worse sleep, and higher opioid utilization following TSA.

Methods: Ninety-three consecutive patients were asked to fill out 2 mental health questionnaires prior to undergoing TSA. Following surgery, patients filled out a daily pain diary to track their daily pain, pain medication use, and quality and duration of their sleep for 30 days. Preoperative opioid use and postoperative refill were determined by the New York State Prescription Monitoring Program. Mixed-model linear regressions were conducted. Significance was defined as $p < 0.05$.

Results: Postoperative opioid refill was associated with female gender, preoperative opioid therapy, higher inpatient opioid use, worse anxiety, depression, somatization, and pain catastrophizing scores. The number of days using opioids postoperatively was associated with worse pain catastrophizing scale (PCS) and somatization scores (patient health questionnaire-15). Preoperative opioid therapy was associated with worse somatization scores, whereas no opioids used after surgery were associated with better somatization scores. Worse sleep quality and duration were associated with worse PCS scores.

Conclusion: A greater mental health burden is associated with worse postoperative pain control and higher opioid utilization during the acute postoperative period. This is especially evident in the pain catastrophizing and somatization domains.

Keywords

Arthroplasty, outcomes, shoulder, cuff tear arthropathy, replacement

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Introduction

Opioid-related deaths increased year-over-year by 32% from 2020 to 2021 and represent 75% of all drug-related overdose deaths.[1] There is a direct correlation between opioid prescriptions and the number of opioid-related deaths.[2] Orthopedic surgeries account for an estimated 8% of initial prescriptions of opioids leading to sustained use beyond 6 months.[3] To curtail this, many national organizations have recommended against the use of strong or long-acting opioids for the treatment of osteoarthritis.[4,5] However, opioid therapy is still indicated to treat acute postoperative pain, and orthopedic surgeons must balance postoperative pain control with the risk of addiction caused by inappropriate opioid use.

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In addition to the addictive qualities of opioids, recent orthopedic literature indicates that surgical outcome is negatively affected by prolonged opioid use including revision rate, infection rate, and functional outcomes. This is well documented in the adult hip and knee reconstruction literature.[6–13] New evidence suggests that TSA results are similarly affected by preoperative and prolonged opioid use.[14–18]

Identification of risk factors leading to prolonged postoperative opioid use remains difficult for surgeons. Multiple risk factors for prolonged postoperative opioid use such as gender, smoking status, and cardiac or other medical conditions have been indicated.[19,20] However, many of these are either nonmodifiable or independent risk factors for worse surgical outcomes, absent their association with opioid use. Additionally, no putative mechanism for these risk factors and their influence on opioid use has been suggested. We believe there may be a connection between a patient's mental well-being and their use of opioid therapy following surgery. The connection between depression and anxiety disorders and worse surgical outcomes has recently been established in patients undergoing TSA.[17,21–24] It is likely that these patients, as well as those with somatization symptoms, and those with poor pain coping strategies (ie, pain catastrophizing) are more likely to anticipate or respond to pain poorly, causing them to use opioids more frequently, higher doses, and/or for longer periods of time. This, in turn, is likely to lead to opioid-induced hyperalgesia and the complications that come with prolonged postoperative opioid use.

In this study, we compare the difference in opioid use, pain control, and overall sleep quality during the acute postoperative period between patients who demonstrate symptoms of anxiety, somatization, and/or depression and those who do not. In doing so, we aim to identify patients who may be at risk of prolonged opioid use following total shoulder arthroplasty (TSA).

Materials and Methods

Study Design and Inclusion Criteria

After obtaining Institutional Review Board Approval, we conducted a prospective cohort study of patients scheduled to undergo primary TSA (reverse or anatomic total TSA) in a single surgeon academic practice between June 2021 and June 2022. Eligible subjects were approached for study participation. Those who were interested provided informed consent and enrolled in the study. Patients were excluded from this study if they were unwilling or unable to participate were undergoing revision TSA, or had previously participated in the study for a prior surgery (eg, contralateral TSA).

Patient-Reported Measures and Postoperative Data Collection

Subjects who consented to participate were asked to complete two mental health screen questionnaires—patient health questionnaire: somatic, anxiety, and depressive symptoms (PHQ-SADS) and pain catastrophizing scale (PCS)—prior to their surgery. Participants were either given a login and password to access a pain diary using their smartphones or the diary on paper, by their preference. Demographics and clinical characteristics were obtained from clinic and hospital electronic medical records. Postoperative opioid prescriptions were provided by a single Orthopedic Nurse Practitioner if the patients were admitted, or by a single surgical Physician Assistant on the day of surgery. The standard opioid prescription on discharge was 30 doses of Hydrocodone-Acetaminophen 5–325 mg, however, this was altered according to the discretion of the above provider as necessary (ie, the patient requested a different opioid, requested no opioid prescription be made, or a different opioid was used during inpatient stay). This variation occurred in 4 patients. One patient was discharged with 30 tablets of Hydrocodone-Acetaminophen 10–325 mg and 3 patients received 30 tablets of Oxycodone-Acetaminophen 5–325 mg. Three of these patients were receiving opioids preoperatively from another practitioner, and another requested a prescription other than hydrocodone due to a perceived adverse effect previously. One refill of the same opioid prescription was made or of a lesser dosage or quantity upon request of the patient. Any additional refills were deferred to the patient's primary care or pain management physician.

On the afternoon of postoperative day 1, patients were notified by text message to fill out the pain diary online, and once more later in the day if still not completed. Participants using the paper version of this received a phone call in the evening. The pain diary interface was closed each day at 2 AM to avoid erroneous answers. This method was carried out daily for 30 days for the electronic version of the pain diary, whereas those with paper diaries were called periodically. The components of the pain diary included a Likert-scale average pain rating, pain medication taken, and sleep duration and quality over the last 24 hours. An example of the pain diary interface is included in the Appendix. If a participant was noted to have missed a day of their pain diary, they were contacted the following day to record the previous day's responses. Participants who had 3 consecutive days or 10 total days of missing information were removed from the study.

After completion of the pain diary, opioid pain medication was recorded and converted into morphine milliequivalents (MMEs) to standardize for differing strengths of narcotics (eg, 5 mg of Hydrocodone is 5 MMEs whereas 5 mg of Oxycodone is 7.5 MME). This data was verified using the New York State Prescription Monitoring Program (NYS-PMP) to confirm the correct dosage and agent prescribed. The NYS-PMP was also queried for opioid prescriptions within 90 days prior to surgery, and opioid refills within 30 days postoperatively. No patients in this study resided outside of New York State, however, nearby state PMP programs reciprocal with New York State were available to search if necessary.

Mental Health Questionnaires

The PHQ-SADS is a composite patient mental health inventory used in primary care settings to screen for 4 common mental health disorders: somatization, generalized anxiety, panic attacks, and depression.[25] These include the patient health questionnaire-15 (PHQ-15) to screen for a somatoform disorder, the 7-item generalized anxiety disorder questionnaire (GAD-7) for generalized anxiety, the PHQ-9 for depression, and a subsection for panic attack disorder. The panic attack subsection was omitted in our protocol. All 3 major scales use 5-, 10-, and 15-point thresholds to indicate mild, moderate, or severe symptoms.

The PCS is a 13-question measure of an individual's perception of pain, divided into 3 domains: rumination, magnification, and helplessness.[26] Participants are asked to rate how frequently they experience each of the 13 thoughts when they are in pain on a 5-point scale where 0 is not at all and 4 is all the time. This results in a composite score as well as 3 subcategory scores for the above-mentioned domains. We use only the composite score in this study.

Statistical Analysis

An a priori sample size estimation was performed and a minimal sample size of 82 would be required in a linear regression model with 2 fixed predictor variables with at least a weak (0.3) multiple partial correlation coefficient between the test predictor and outcome variable. The continuous variables were found to be non-normally distributed. Therefore, Spearman's correlation was calculated between preoperative opioid use, postoperative opioid use, and mental health measures. Mixed-model linear regressions using an autoregressive covariance pattern with intercept and a random effect for each subject were performed predicting postoperative opioid use with the main effect of mental health measures and time since operation, and the interaction term of patient-reported measure and time since operation. Similar models were built to predict postoperative pain, sleep quality, and sleep duration. The sample was then grouped as opioid refill or not opioid refill and compared. Continuous measures were compared using an independent samples *t*-test, and categorical variables were compared using a chi-squared test (Fisher's exact if cell sizes were below 5). The sample was also grouped by whether they consumed any postoperative opioids or not and compared. Lastly, a mixed model linear regression was performed predicting postoperative opioid use with the main effect of preoperative opioid use (binary), time since operation, and the interaction of preoperative opioid use and time since operation. A p-value of $<.05$ was considered statistically significant and all analyses were performed using SPSS Version 28 (Armonk, NY).

Results

Demographics and Surgical Characteristics

One hundred twenty-three consecutive patients were eligible and consented to participate, of whom 93 were included in the final analysis. A sample inclusion flowchart is presented in Figure 1. Eighteen patients (19%) were found to have filled an opioid prescription within 90 days of their surgery. Glenohumeral arthritis was the most common primary diagnosis, accounting for 62 (66.6%) of the diagnoses. Of the participants with glenohumeral arthritis, 2 participants had previously failed a rotator cuff repair, and 2 had undergone a previous instability procedure. Thirty participants underwent surgery for rotator cuff arthropathy, 4 of which also had a history of rotator cuff repair. Two participants had avascular necrosis and 1 participant had malunion of a proximal humerus fracture treated nonoperatively. The mean length of stay was 0.52 nights (range 0-2), and 90 (96.8%) participants were discharged home while the remaining were discharged to subacute rehab.

Postoperative Complications

No intraoperative complications were reported. Two participants demonstrated signs and symptoms of an acromial stress fracture in the early postoperative period. Both participants had the diagnosis confirmed with a computed tomography scan and were treated nonoperatively. Both participants did not differ significantly from the rest of the sample in any measure and were therefore included in the final analysis. One participant was readmitted for a small pulmonary embolism after a syncopal episode and was treated and discharged the following day. One participant returned to the emergency department following same-day discharge for urinary retention. As stated above and shown in Figure 1, 1 participant was removed from the study due to infection. No other participant experienced any complications during the study period.

Preoperative Opioid use

Preoperative opioid use had a positive correlation with PHQ-15 ($\text{rho} = 0.346$, $p < .001$), but not with PCS ($\text{rho} = 0.166$, $p = .112$), GAD-7 ($\text{rho} = 0.174$, $p = .096$) or PHQ-9 ($\text{rho} = 0.094$, $p = .368$).

Postoperative Opioid Consumption

Mean MME during an inpatient stay, PHQ-SADS subcategory scores, and pain catastrophizing scores at the time of surgery are presented in Table 1 along with their correlations to each other. Each element of the PHQ-SADS and PCS significantly correlated with each other. Mean opioid consumption during inpatient stay had a significant positive correlation with PCS, but not with any of the 3 measures within the PHQ-SADS.

There was no correlation between preoperative and daily postoperative opioid consumption ($\text{rho} = 0.113$, $p = .279$). Figure 2 presents the mean MME use during the postoperative period stratified by whether they used opioids within 90 days leading up to surgery or not.

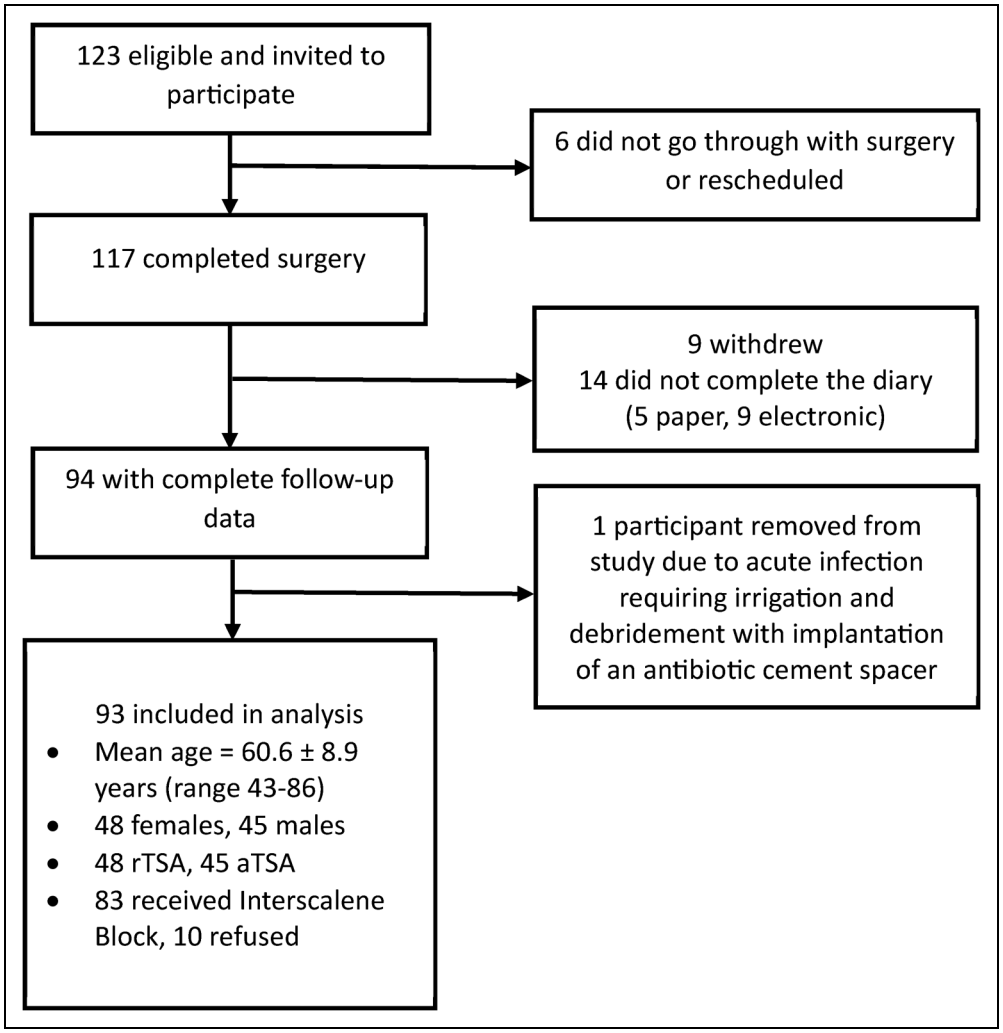

Figure 1. Flowchart of patient recruitment and retention.
Abbreviations: aTSA, total shoulder arthroplasty; rTSA, reverse total shoulder arthroplasty.

Table 1. MME Usage During the Inpatient Stay and Patient-Reported Mental Health Measures at the Time of Surgery SD.

	Mean ± *SD*	Correlation with MME	Correlation with PCS	Correlation with PHQ-15	Correlation with GAD-7	Correlation with PHQ-9
MME	5.47 ± 11.95*	—	—	—	—	—
PCS	10.09 ± 9.30	**0.359 (*p* < .001)**	—	—	—	—
PHQ-15	5.94 ± 2.98	0.082 (*p* = .434)	0.378 (*p* < .001)	—	—	—
GAD-7	2.51 ± 3.47	0.113 (*p* = .280)	0.570 (*p* < .001)	0.577 (*p* < .001)	—	—
PHQ-9	2.68 ± 3.13	0.022 (*p* = .831)	0.433 (*p* < .001)	0.575 (*p* < .001)	0.693 (*p* < .001)	-

Abbreviations: *SD*, standard deviation; MME, morphine milliequivalent; PCS, pain catastrophizing scale; PHQ-15, patient health questionnaire-15; GAD-7, 7-item generalized anxiety disorder questionnaire; PHQ-9, patient health questionnaire-9.
*The *SD* is greater than the mean as the data is not normally distributed due to most patients ($n = 69$) not taking any opioids during their inpatient stay or being discharged home on the day of surgery.
Bolded values represent statistically significant correlation with inpatient MME.

Results of independent mixed-model regressions predicting mean opioid use over time using patient-reported mental health measures are presented in Table 2. Mean opioid use significantly decreased over time since operation in each regression model, however, the main effect or the interaction term of main effect and time was not significant for any patient-

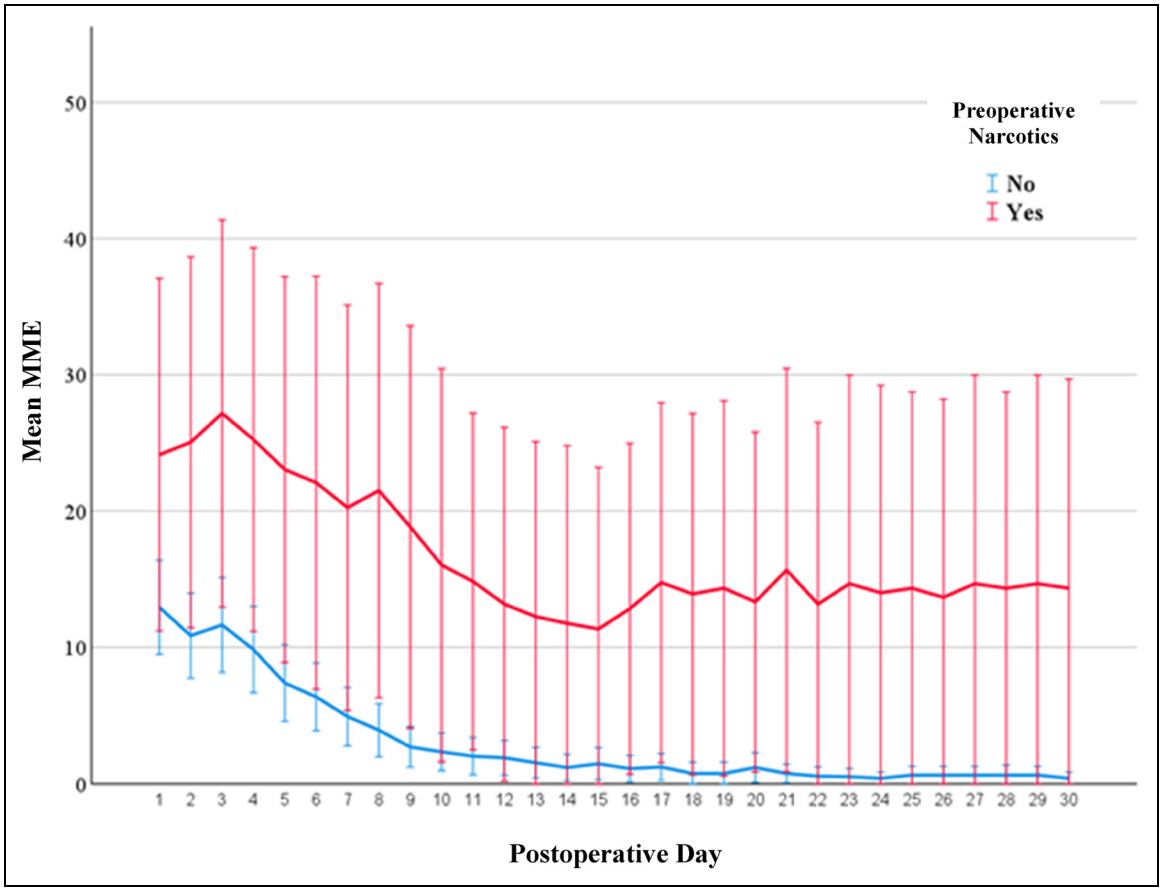

Figure 2. Comparison of pain medication used in morphine milliequivalents (MMEs) per day comparing those who did and those who did not fill an opioid prescription within 90 days prior to surgery.

Table 2. Estimates of Fixed Effects of Independent Regressions Predicting MME Use Postoperatively.

	Main effect		Time		Intercept		Interaction main effect × time	
	F	*p*-value	*F*	*p*-value	*F*	*p*-value	*F*	*p*-value
PCS	1.411	.236	18.508	<.001	12.800	>.999	0.370	.543
PHQ-15	3.353	.069	6.950	.009	0.560	>.999	0.334	.564
GAD-7	2.321	.129	35.213	<.001	46.202	<.001	0.128	.721
PHQ-9	0.035	.853	26.709	<.001	0.276	.599	0.053	.818

Abbreviations: MME, morphine milliequivalent; PCS, pain catastrophizing scale; PHQ-15, patient health questionnaire-15; GAD-7, 7-item generalized anxiety disorder questionnaire; PHQ-9, patient health questionnaire-9.

reported mental health measure. When analyzing patient-reported mental health measures and the number of days of opioids used postoperatively (as a fraction of total days reported), we found a correlation with PCS (rho = 0.235, p = .023) and PHQ-15 (rho = .292, p = .005) but not with GAD-7 (rho = 0.168, p = .108) or PHQ-9 (rho = 0.084, p = .425).

Postoperative Opioid Refills

Twenty-three (24.7%) participants refilled their opioid prescriptions during the follow-up period. Groupwise demographics and clinical characteristics are presented in Table 3. The group that refilled opioids had more females, had a higher incidence of preoperative opioid use, used more opioids during inpatient stay, and reported worse on all pain catastrophizing and mental health measures.

Postoperative Pain, Sleep Quality, and Sleep Duration

The summary of all independent regressions predicting postoperative pain, sleep quality, and sleep duration using postoperative

Table 3. Groupwise Demographics and Clinical Characteristics Comparing Patients Who Refilled Opioids and Those Who Did Not.

	Refilled opioids	Did not refill opioids	*p*-value
N	23	70	—
Age in years	66.57 ± 7.86	69.27 ± 9.19	.208
Sex	7 male, 16 female	38 male, 32 female	.047
Diagnosis	13 glenohumeral arthritis, 9 rotator cuff arthropathy, 1 other	47 glenohumeral arthritis, 21 rotator cuff arthropathy, 2 AVN	.329
Procedure	12 aTSA, 11 rTSA	33 aTSA, 37 rTSA	.675
Preoperative opioids	11 yes (48%)	7 yes (10%)	<.001
Perioperative			
MME	10.82 ± 18.97	3.72 ± 7.95	.013
PCS	14.48 ± 8.69	8.64 ± 9.10	.008
PHQ-15	8.52 ± 2.52	5.09 ± 2.62	<.001
GAD-7	4.35 ± 4.29	1.90 ± 2.94	.003
PHQ-9	4.43 ± 4.13	2.10 ± 2.50	.002
Inpatient stay in days	0.57 ± 0.73	0.50 ± 0.61	.672

Abbreviations: AVN, avascular necrosis; aTSA, anatomic total shoulder arthroplasty; rTSA; reverse total shoulder arthroplasty; MME, morphine milliequivalent; PCS, pain catastrophizing scale; PHQ-15, patient health questionnaire-15; GAD-7, 7-item generalized anxiety disorder questionnaire; PHQ-9, patient health questionnaire-9.

Table 4. Summary of Independent Regressions Predicting Postoperative Pain, Sleep Quality, and Sleep Duration.

	Main effect		Time		Intercept		Interaction main effect × time	
	F	*p*-value	*F*	*p*-value	*F*	*p*-value	*F*	*p*-value
Postoperative pain								
PCS	9.271	.003	35.074	<.001	110.818	<.001	0.422	.517
PHQ-15	8.383	.004	10.944	.001	54.866	<.001	0.973	.325
GAD-7	6.495	.011	31.228	<.001	144.923	<.001	1.933	.164
PHQ-9	4.279	.040	35.641	<.001	121.973	<.001	2.363	.125
Sleep quality								
PCS	6.740	.010	9.703	.002	1251.780	<.001	0.197	.657
PHQ-15	0.409	.523	4.082	.044	492.302	<.001	0.059	.808
GAD-7	0.953	.329	13.463	<.001	9.185	.002	0.435	.510
PHQ-9	0.554	.457	13.781	<.001	0.656	>.999	0.022	.883
Sleep duration								
PCS	8.529	.004	2.562	.110	1377.122	<.001	0.886	.347
PHQ-15	0.095	.758	0.313	.576	601.354	<.001	1.128	.289
GAD-7	0.029	.865	7.899	.005	48.235	<.001	0.021	.883
PHQ-9	0.249	.618	4.948	.027	1737.396	<.001	0.278	.598

Abbreviations: PCS, pain catastrophizing scale; PHQ-15, patient health questionnaire-15; GAD-7, 7-item generalized anxiety disorder questionnaire; PHQ-9, patient health questionnaire-9.

patient-reported mental health measures is presented in Table 4. No interaction term had a significant effect on any model. Postoperative pain was significantly decreasing over time and was significantly affected by all mental health measures, with higher scores correlating with worse pain. Sleep quality was also improving over time but only significantly correlated with PCS. Sleep duration, however, improved for half of the models while the other half did not change over time. Only the main effect of PCS was significant, with higher symptom burden correlating with less sleep duration.

No Opioids Used Postoperatively

Lastly, there were 16 participants who did not take any opioids in the postoperative period following discharge. Groupwise demographics and clinical characteristics are presented in

Table 5. Groupwise Demographics and Clinical Characteristics Comparing Patients Who Used Opioids Postoperatively and Those Who Did Not.

	Did not use opioids	Used opioids	*p*-value
N	16	77	—
Age in years	70.69 ± 6.46	68.17 ± 9.32	.306
Sex	6 male, 10 female	39 male, 38 female	.338
Diagnosis	8 glenohumeral arthritis, 6 rotator cuff arthropathy, 2 AVN	52 glenohumeral arthritis, 24 rotator cuff arthropathy, 1 other	.088
Procedure	6 TSA, 10 rTSA	39 TSA, 38 rTSA	.338
Preoperative opioids	1 yes (6%)	17 yes (22%)	.183
Inpatient MME	1.09 ± 3.02	6.38 ± 12.89	.002
PCS	6.69 ± 7.48	10.79 ± 9.53	.109
PHQ-15	4.50 ± 2.19	6.23 ± 3.05	.034
GAD-7	1.19 ± 2.17	2.78 ± 3.63	.095
PHQ-9	2.50 ± 3.12	2.71 ± 3.15	.805
Inpatient stay in days	0.38 ± 0.50	0.55 ± 0.66	.322

Abbreviations: AVN, avascular necrosis; aTSA, anatomic total shoulder arthroplasty; rTSA; reverse total shoulder arthroplasty; MME, morphine milliequivalent; PCS, pain catastrophizing scale; PHQ-15, patient health questionnaire-15; GAD-7, 7-item generalized anxiety disorder questionnaire; PHQ-9, patient health questionnaire-9.

Table 5. These participants used fewer opioids during their inpatient stay and had lower (better) PHQ-15 scores than participants who used opioids during the postoperative period but did not differ in any other clinical characteristics or demographics.

Discussion

A growing body of evidence suggests that patients with anxiety and depression are more likely to experience worse outcomes and higher complications following total TSA.[17,22,23,27] This is thought to be, in part, due to the higher likelihood for these patients to require prolonged opioid therapy.[14,20] In this 30-day prospective cohort study, we sought to demonstrate a clearer link between patient mental health characteristics and postoperative pain control.

Our findings suggest that postoperative pain is significantly correlated with any 1 of the 4 mental health scores used in this study. Furthermore, each of the mental health scores was predictive of a higher likelihood of opioid refill in the 30-day period with a higher symptom burden. Although opioid refill does not define prolonged opioid use, it should be noted that Brat et al[28] demonstrated a 44% increase likelihood of opioid abuse among opioid-naive patients with each refill following surgery. Similarly, Spencer et al[20] found that while only 25% of patients undergoing TSA in a large database study required an opioid refill, over half of those patients were found to be using opioids beyond 6 months postoperatively.

Interestingly, we were unable to demonstrate an association between postoperative opioid consumption and prescription refills. We did find, however, that higher symptom burden on PCS and PHQ-15 surveys were predictive of higher daily opioid consumption postoperatively. Incidentally, both surveys were predictive of a higher likelihood of opioid refill if the symptom burden was higher. Our inability to find a link between postoperative opioid consumption and prescription refill may be due to a less-than-standard protocol with pain medication discharge, and other prescribers refilling medication postoperatively. This is partially why we decided to utilize a patient-driven pain diary that allowed us to better appraise opioid consumption during the postoperative period. This allows us to bypass the errors that classically come with nonstandardized prescribing protocols.

PCS and PHQ-15 were the most frequently encountered predictive scores in our study. Other than postoperative pain and opioid refill, the GAD-7 (anxiety domain) and PHQ-9 (depression domain) were not associated with any other outcome in our study. In addition to the previously mentioned associations, PCS was also predictive of higher inpatient opioid consumption as well as shorter sleep duration and worse sleep quality. This highlights a particular strength of our study, as neither the PCS nor the PHQ-15 have a similar questionnaire via the Patient-Reported Outcomes Measurement Information System Mental Health.

Pain catastrophizing has been indicated in several studies to modulate postoperative[29–31] and posttraumatic pain.[32,33] Pain catastrophizing represents an important interplay between perceived pain experience for both the person experiencing the pain and those to whom the individual is trying to communicate their pain.[34] That is, those with pain catastrophizing traits tend to utilize fewer pain coping strategies in the presence of other individuals.[35] This may help to explain why the PCS was the only mental health score correlated with higher opioid utilization as an inpatient.

In addition to worse postoperative pain and a higher likelihood of opioid refill postoperatively, a higher symptom burden on the PHQ-15 (somatization) was associated with a higher likelihood of preoperative opioid use, while a lower symptom burden was associated with not requiring opioids postoperatively. Somatic symptom disorder is usually grouped with Anxiety and Depressive disorders into the "Somatic, Anxiety, and Depression Triad (SAD triad)" given their relatively high frequency of overlap.[25,36] Comorbidity with more than 1 component of the SAD triad has been found to be predictive of higher healthcare utilization.[36] Although somatic symptom disorder occurs with the relatively same frequency as anxiety and depression,[36] it is often neglected in orthopedic research. Based on the results of this study, it may be useful to incorporate somatization diagnoses in future research and to better understand the relationship between mental health and postoperative pain control.

It should be noted that the short duration of patient follow-up in this study is unable to demonstrate any connection between these mental health syndromes and prolonged opioid use or complications caused by prolonged opioid use. Additional limitations include a relatively small sample size and potential reporting biases. Attrition was relatively small; of the 117 who consented to participate in the study and underwent surgery, only 9 withdrew voluntarily and 14 did not complete the pain diaries. However, the stigma surrounding opioid use and mental health may have affected participant responses on both the mental health questionnaires and the pain diary.

Our findings help to support our hypothesis that postoperative pain control is correlated with patient mental health characteristics. Most notably, the somatoform phenotype (eg, PHQ-15) and catastrophic behavior toward pain (PCS) had the most consistent relationship with our findings in this study.

Further research may study longer-term follow-ups to determine if these mental health questionnaires can be useful in predicting prolonged opioid and surgical outcomes. Based on the results of this study, it may be useful to include consideration for somatization and pain catastrophizing in these studies going forward.

Conclusion

A higher burden of mental health symptoms, especially somatization and pain catastrophizing, is associated with worse pain control, worse sleep duration and quality, and a higher likelihood of requiring opioid prescription refills in the acute postoperative period. These tools may be useful in predicting which patients are at risk of prolonged opioid use postoperatively and the associated complications.

Declaration of Conflicting Interests

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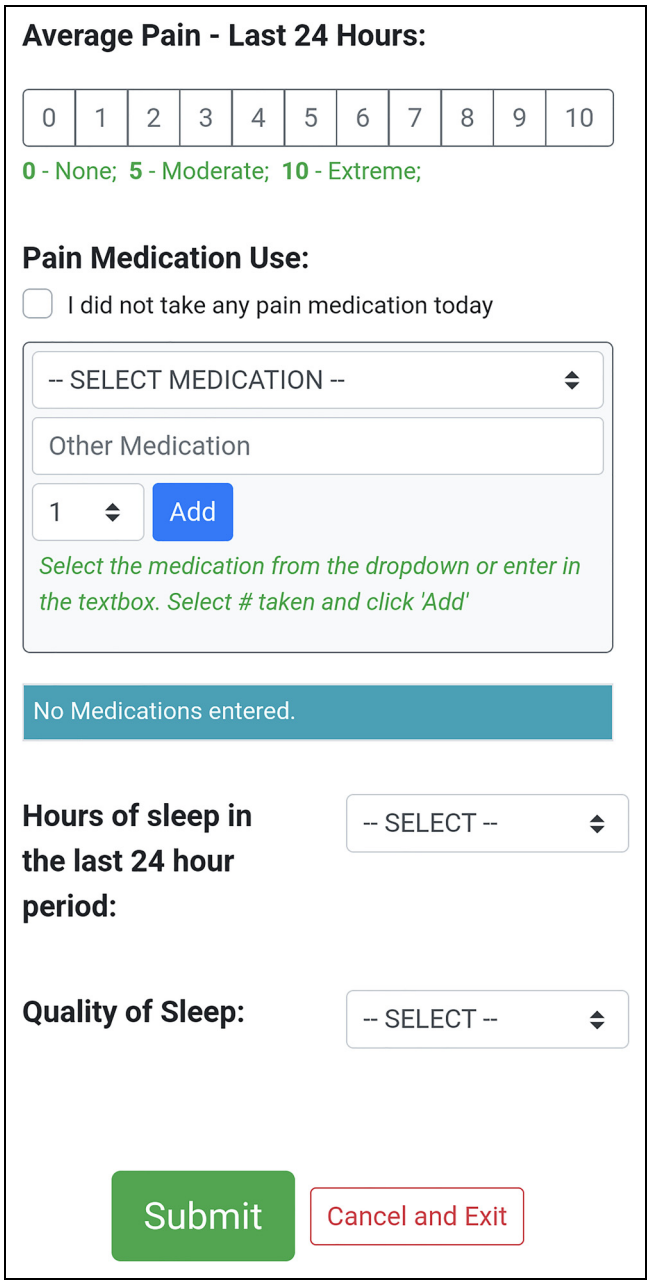

Appendix 1. Screen Capture of Electronic Pain Diary User Interface.