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RESEARCH

An analysis of the impact of a multimodal therapy order set on postoperative opioid prescribing after orthopedic shoulder procedures

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ABSTRACT

Background: Opioids are effective for postoperative pain control but are no longer considered appropriate as the sole method for managing pain after surgery. Newer, multimodal approaches to pain control are increasingly being employed to decrease reliance on opioids, but patient-related outcomes are not consistently reported with these interventions.

Objective: This study evaluated the effect of implementing a new multimodal therapy order set, coupled with new patient education materials, on postoperative outcomes after complex shoulder surgery.

Methods: This retrospective cohort study compared outcomes from patients who received medications via the new multimodal therapy order set (order set cohort) and patients who did not (nonorder set cohort). All patients were contacted on postoperative days 1,7, and 14 to answer questions about postoperative pain and general measures of function. Data on opioid prescribing and use were collected. There were 2 primary endpoints: median morphine equivalent daily dose (MEDD) prescribed at 14 days postsurgery and median satisfaction with pain control at 14 days postsurgery.

Results: There were 16 patients included in the nonorder set cohort and 19 in the order set cohort. At 14 days postsurgery, the median MEDD prescribed was significantly less in the order set cohort than in the nonorder set cohort ($P = 0.003$), and there was no significant difference in patient satisfaction scores between groups.

Conclusion: The implementation of a multimodal order set, coupled with new patient education materials, resulted in a significant reduction in the median MEDD of prescribed opioids without negatively influencing patient satisfaction after complex shoulder interventions.

Background

Opioids are an appropriate and effective modality for postoperative pain control; however, the notion that opioids should be the primary and sole method employed for pain control after a surgical intervention is rapidly becoming obsolete. The ongoing opioid epidemic, which continues to negatively impact the lives of many individuals across the country, has highlighted the fundamental flaws of the opioid-only approach to pain control. According to a 2018 estimation by the Substance Abuse and Mental Health Services Administration, 9.9 million Americans have misused prescription pain relievers in the past year.[1] In a 2017 systematic review by Bicket et al., it was estimated that 42%–71% of postoperative opioid tablets went unused.[2] Moreover, the authors also found

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Key Points

Background:

- Development of a multimodal postoperative order set reduced the number of leftover opioids in the community.
- Multimodal approaches to pain control are increasingly being employed to decrease reliance on opioids but patient-related outcomes are not consistently reported with these interventions.

Findings:

- Implementation of a multimodal order set, coupled with patient education, can significantly reduce the MEDD of prescribed opioids without negatively influencing patient satisfaction after complex shoulder procedures.

that 67%–92% of patients reported having unused opioids after recovery from surgery.[2] Together, these findings imply that most opioid prescriptions exceeded the necessary supply based on patient ultilization.[2] Given that undergoing a surgical procedure is often a patient's first introduction to opioids in the outpatient setting, the over-prescribing of prescription opioids by the patient's surgeon opens the door for potential opioid misuse.[3,4] This could begin a cascade of negative effects leading to potential dependence, addiction, and distribution to other members within society.[3,4] Consequently, optimization of postoperative prescribing is an essential measure in decreasing unnecessary opioid use and potential misuse.

New standards are emerging for the prescribing of opioids in the postoperative setting. A 2017 review by Ljungqvist et al. recommended the use of standardized multimodal opioid-sparing order sets for care of the postoperative surgical patient.[5] The use of opioid-sparing order sets is an ongoing area of study in different procedural settings. A 2022 study by Anyaehie et al. illustrated the profound benefit of an opioid-sparing multimodal postoperative approach to reduce inpatient opioid requirements in women requiring emergent cesarean delivery.[6] The multimodal order set decreased inpatient opioid consumption, reduced pain scores, and decreased the need for inpatient patient-controlled analgesia implementation.[6]

Despite the increasing importance of multimodal therapies for pain associated with orthopedic procedures, there are significant gaps in the current literature. Most of the data currently available on multimodal pain control focuses on total joint arthroplasty of the knee and hip, which can limit applicability to procedures at other sites.[7] Few studies have evaluated patient outcomes associated with multimodal interventions beyond tablet prescribing and use. As pain is a subjective finding that varies appreciably from person-to-person, it is imperative that the patient experience is examined along with more objective findings like tablet prescribing numbers.

In collaboration with the pain stewardship program, the orthopedic surgery department at a large academic medical center recently developed and implemented a new postoperative multimodal therapy order set (Figure 1) for outpatient orthopedic surgical procedures. The aim of this order set is to decrease excessive opioid prescribing and to optimize multimodal therapy during the postoperative period. The order set separates procedures into 2 categories: simple and complex. The surgeons involved with order set development created these 2 categories to classify procedures according to how much pain medication a patient would be expected to need (with simple procedures requiring less pain medication than complex). In the order set, providers can then select a preferred opioid for postoperative pain (tramadol or oxycodone) with quantity limits dictated by whether it was a simple or complex procedure. These quantity limits are lower than the previous defaults, however, within the order set there were suggested refill e-scripts that were available if requested, to mitigate the potential time burden if more patients were to require refills due to lower initial dispensing quantities. The order set also preselects acetaminophen and ibuprofen to be prescribed on a scheduled basis for every patient, in addition to a stimulant laxative if an opioid is selected (see Figure 1 for specific dosing regimen). For patients with significant kidney or liver dysfunction, the order set has prompts for providers about removing orders for ibuprofen or acetaminophen when appropriate. In conjunction with this prescribing order set, new patient education materials were developed that tailor instructions to the specific regimen prescribed, promote the proper use of nonopioid medications, and recommend multiple nonpharmacologic interventions for pain. The nonpharmacologic interventions recommended included ice, rest, meditation, mindfulness, and music or art therapy. In addition, the new materials cover how to taper off opioids and how to properly dispose of extra tablets. Patients are instructed to move to using the ibuprofen and acetaminophen as needed once they no longer need opioids for pain. Prior to this new order set intervention, there were no specific patient education materials provided to patients about pain.

During the implementation of this new multimodal therapy order set, patients were contacted about postoperative pain, satisfaction, and opioid use to ensure that order set implementation did not lead to any adverse outcomes for patients. This study evaluated the impact of the implementation of this new multimodal therapy order set on the prescribing of opioid pain medications, postoperative pain control, and patient satisfaction in a subset of patients undergoing shoulder procedures.

Methods

This retrospective cohort study was approved by the Institutional Review Board at the University of Cincinnati. Outcomes were examined for 2 cohorts of patients who underwent outpatient orthopedic shoulder procedures at a large multicenter academic institution in Cincinnati, Ohio, in 2022. The first cohort included patients who received care from surgeons who had not yet implemented the new multimodal therapy order set for postoperative pain (nonorder set cohort). The second cohort included patients who received care from surgeons who had implemented the new multimodal therapy order set (order set cohort). A total of 4 orthopedic surgeons agreed for their patients to participate in the quality assurance process, 2 in the nonorder

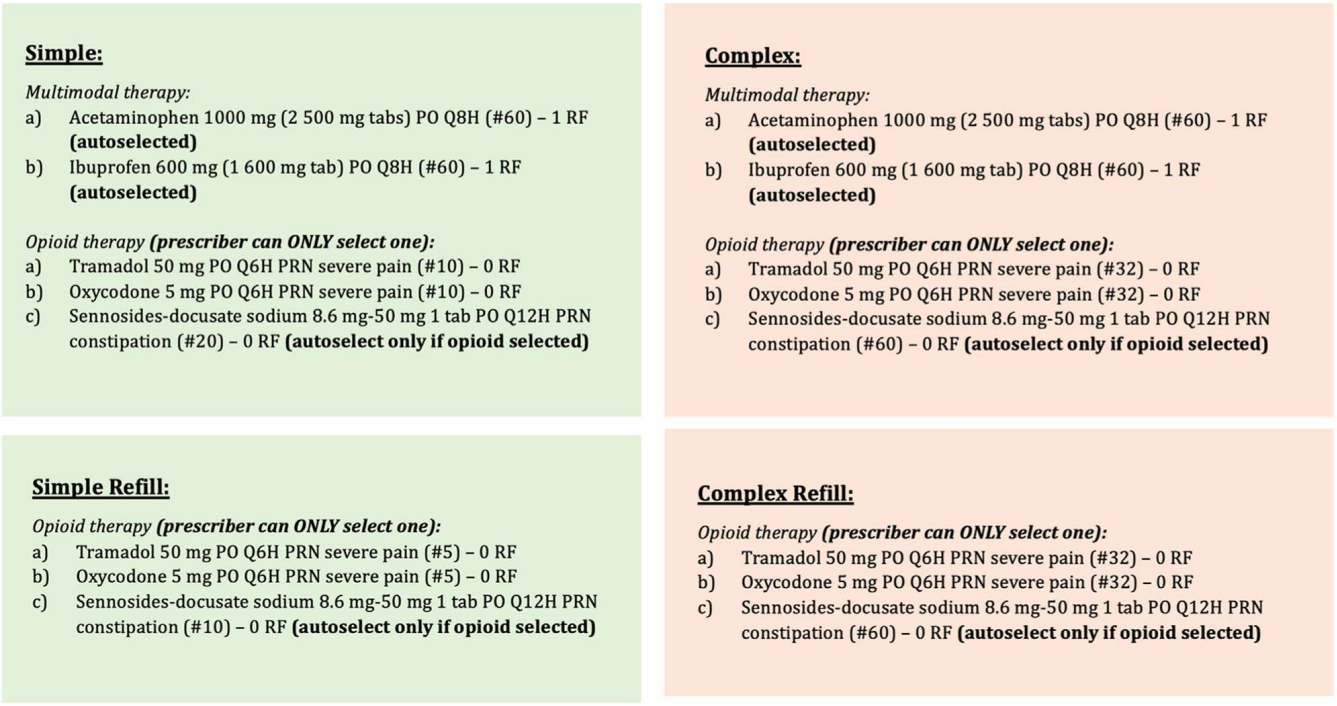

Figure 1. Multimodal therapy order set.

set cohort, and 2 in the order set cohort. The 2 surgeons in the nonorder set cohort delayed implementation of the new order set when it launched so their patients represent nonorderset care. The 2 other surgeons implemented use of the new order set immediately when it was initially launched, and their patients comprised the order set cohort.

During the implementation phase of the new multimodal therapy order set, patients were contacted via phone for quality assurance purposes. Both patients who had not received prescriptions from the new order set (the nonorder set cohort) and patients who had received prescriptions from the new order set (order set cohort) were contacted on days 1,7, and 14 postoperatively. Patients who underwent orthopedic procedures involving joints other than the shoulder were contacted as part of the quality assurance process but were not included in this study. During the phone call, patients were asked several questions assessing pain control, comfort, medication effectiveness, functional status, and sleep, and this information was recorded by the caller. For quality assurance, patients were asked questions in a standardized order and format to reduce bias. If a patient did not answer the telephone, the caller left a Health Insurance Portability and Accountability Act-compliant voicemail with a call back number. Patients who were unable to be contacted were not called again until the next follow-up call either on day 7 or day 14. The phone calls were completed over a 12-month period from 2022 to 2023.

This research study retrospectively assessed the data collected in these quality assurance phone calls from a subset of the patients contacted. The number of patients included in the study was limited by the number of completed phone calls that resulted in complete data documentation. Inclusion criteria for this study included patients who were at least 18 years of age, were English-speaking, had a procedure classified as "complex" by the new order set standards, and underwent a left or right shoulder procedure performed by one of the participating surgeons in the study (procedures may include shoulder arthroscopy, shoulder arthroplasty, total shoulder revision, bicep tendosis, rotator cuff repair, labral debridement and repair). The exclusion criteria was lack of completed 14-day survey data and previous enrollment in the study.

The first primary endpoint of this study was the median morphine equivalent daily dose (MEDD) prescribed at 14 days postsurgery, reported as MEDD based on opioid prescriptions prescribed outpatient. The second primary outcome was median satisfaction with pain control on a scale of 0—10 at 14 days postsurgery.

Multiple secondary endpoints were assessed. The median quantity of opioid tablets prescribed was determined from review of the electronic medical record, and the median number of opioid tablets taken was assessed via patient reporting. The number of patients receiving multimodal therapy was recorded based on discharge prescriptions and was recorded as binary (yes/no) for all patients. Day 14 of patient-reported outcomes from the phone call surveys were used to assess the following endpoints: patient-reported comfort level, postprocedural pain, pain regimen effectiveness, functional ability, and sleep. The use of nonpharmacologic methods for pain relief was recorded for all patients from survey evaluations as binary (yes/no). Patient-reported experience of receiving adequate education and health care team meeting expectation for pain control was recorded as binary (yes/no) from the day 14 telephone survey. Lastly, the number of patients who reported they knew how to dispose of unused opioid tablets was recorded as binary (yes/no) for all patients enrolled. Questions used on the day 14 phone survey are included in Figure 2. Chart reviews were conducted to evaluate the number of patients in each group

Question	Prompted Responses
How would you describe your comfort level over the past week? Was it.....	Comfortably Manageable Tolerable with discomfort No pain
How would you describe your post-procedural pain? Is it...	About the same Getting better
Overall, how would you describe your pain control? Was it.....	Very effective Somewhat effective
How would you describe your functional ability this week? Do you feel like you..	Can do most things Can do some things
How would you describe your sleep? Are you....	Awake all night with pain Awake occasionally with pain Normal sleep
Did you feel that you were given adequate education and expectations regarding your pain control regimen?	Yes No
Were you allowed to participate in decisions about your pain treatment as much as you wanted to?	Yes No
What one number that best shows how satisfied you are with the results of your pain treatment:	1 (completely unsatisfied) – 10 (very satisfied)
Did you use any non-medicine methods to relieve your pain?	Yes No
If yes, what?	
How many tablets did you use of your opioids?	

Figure 2. Day 14 phone call survey questions.

that required an Emergency Department visit within 1 week of surgery, and Ohio Automated Rx Reporting System reports were utilized to evaluate opioid naïve status at the time of surgery, and the number of patients who were prescribed opioids 1-year after their procedure.

In the statistical analysis, continuous variables were compared using the t-test or Mann—Whitney rank sum test and categorical variables were compared with Chi-square or Fischer's exact test. A *P*-value of <0.05 was considered significant. The statistical analysis was performed using GraphPad (Prism) and Microsoft Excel (version 16.88).

Results

A total of 16 patients had complete data documentation and met inclusion criteria for the nonorder set cohort. A total of 35 patients who received care using the new orderset were contacted, but only 19 patients met inclusion criteria for the order set-cohort. The majority of patients were excluded due to lack of 14-day survey data. All patients in the study were classified as undergoing a complex surgical intervention for the purposes of the new order set. Age and body mass index were similar between the 2 cohorts, but there were only 3 females in the nonorder set cohort (18.8%), whereas the order set cohort was more evenly balanced with 9 female and 10 male patients. Approximately 80% of patients in both cohorts were White and almost all patients were opioid naïve at the time of surgery, with the exception of 1 patient in the nonorder set cohort (Table 1).

For the first primary outcome, the median MEDD prescribed by day 14 postsurgery, the nonorder set cohort had significantly higher median MEDD than the order set cohort (60 MEDD nonorder set Vs. 30 MEDD order set, $P = 0.003$) (Table 2). The second primary outcome was median satisfaction with their pain regimen on a scale of 0—10 at 14 days postsurgery. No statistically significant difference was found between median nonorder set cohort and order set cohort satisfaction scores (9 nonorder set Vs. 8 order set, $P = 0.598$).

There were no significant differences in any of the secondary outcomes between the nonorder set and order set cohorts except for the number of leftover tablets in the community based upon the number of opioids prescribed compared to the number of opioids used (Table 3). Although not statistically significant, the median quantity of tablets prescribed decreased with the new order set implementation (50 tablets nonorder set Vs. 32 order set, $P = 0.099$) reflecting the new tablet quantity prescribing defaults. Despite this change, the mean number of tablets used in both the nonorder set and the order set cohort was 13.5 tablets ($P = 0.961$). With the lower initial quantity of opioids prescribed in the new order set, 16% of patients (3/19) used the refill provided in the order set cohort while only 6% (1/16) patients required a refill

Table 1
Population characteristics

Characteristics	Non-order set (n = 16)	Order set (n = 19)
Age, y— mean (range)	53.25 (19—74)	56.1 (24—79)
Sex, n — female/male	3/13	9/10
BMI — mean (range)	30.4 (23—48)	30.1 (20—42)
Opioid naïve at surgery	15 (94%)	19 (100%)
Race -%		
White	81.25%	78.9%
Black/African American	0%	10.5%
Hispanic	12.5%	5.3%
Asian	6.25%	5.3%
Surgical procedure classification — Complex, %	100	100
Surgeon - n		
Surgeon 1/Surgeon 2	1/15	
Surgeon 3/Surgeon 4		7/12

Abbreviation used: BMI, body mass index.

Table 2
Primary outcomes

Primary outcomes	Nonorder set cohort (n = 16)	Order set cohort (n = 19)	*P* value
Median MEDD prescribed at 14 d postop	60 (30–60)	30 (30–30)	0.003
Median satisfaction (from 0-10, 10 being the best) with the pain regimen at 14 d postop	9 (7–10)	8 (7–10)	0.598

Abbreviation used: MEDD, median morphine equivalent daily dose.

in the nonorder set cohort ($P = 0.608$) that received higher initial quantities. While the number of refills requested did increase (albeit nonsignificantly) with the use of the order set, the estimated number of leftover/unused opioids that remained in the community was 459 (29 tablets per patient) in the nonorder set group and 370 (20 tablets per patient) ($P = 0.03$) in the order-set group representing a significant decrease in left-over opioids in the community. Multimodal therapy was used by 88% in the non-order set cohort Vs. 100% of the patients in the order set cohort ($P = 0.202$). In both the non-order set and order set cohorts, use of nonpharmacologic methods of pain control were employed frequently: 87.5% (14/16) patients in the non-order set cohort and 94.7% (18/19) in the order set cohort. Use of cold therapy (ice packs or machines) was the primary nonpharmacologic intervention used by all of the respondents. No patients in either group required an emergency department visit within the first week postoperative, and 3 patients were still on opioids 1-year after their surgery date, 2 in the nonorder set group and 1 in the order-set group.

For patient satisfaction outcomes, no significant differences were identified between groups. The percentage of patients that rated their pain regimen as "very effective" at day 14 was similar, 69% in the nonorder set cohort and 74% in the order set cohort ($P = 1.00$). Measures related to sleep, daily activities, and feeling better at day 14 were similar between the 2 cohorts (Table 3). When questioned about adequate education and the health care team meeting expectations, 100% (16/16) of patients in the nonorder set cohort and 94.7% (18/19) of patients in the order set cohort responded affirmatively.

Discussion

The opioid epidemic has prompted much discussion and study within the medical community about optimal strategies for treating pain. Although progress has been made in limiting opioids as the primary method for pain control postoperatively, they are often still necessary. It remains a challenge to strike an equilibrium between adequate pain control and minimizing the potential for addiction. Moreover, although surgical pain is an indication that often requires opioid medications, it is also an area where high numbers of opioids are traditionally prescribed and often go unused.[2] In a prospective survey, Wyles et al. examined opioid prescribing patterns after 7 elective orthopedic procedures. Their findings were telling: 60% of prescribed opioids were not used and 77% of people had leftover opioids.[8] In our study, we did find a significant decrease in the median MEDD prescribed to patients between the nonorder set and order set cohorts. However, the mean number of tablets used did not change. The implementation of the order set did result in a lower ratio of tablets used to tablets prescribed. A mean of 13.5 tablets were used of a median 50 tablets prescribed in the nonorder set cohort, whereas a mean of 13.5 tablets were used with a median number prescribed of 32 in the order set cohort. Furthermore, only 3 of the 19 patients in the order set cohort requested the refill. This evidence supports the decision to lower the default number of tablets initially prescribed in the new order set to better align with what the majority of patients will need for pain control, significantly reducing the amount of left-over opioids in the community, while incurring a nonsignificant increase in the number of refills.

The principal concern with leftover opioid tablets is the potential for misuse and addiction. A study by Pittet et al. evaluated medication fill records for 13,970 opioid naïve adults after a surgical procedure; 21.2% of patients had persistent opioid use in the 3–12 months after surgery.[3] Beyond the potential addiction for the patient, those with close access to the medications could divert or develop an addiction. This can even occur without the patient's knowledge—the review by Bicket et al. reported that over 70% of people do not keep opioids stored in locked containers.[2] One way to combat this problem is to teach people safe disposal methods for unneeded opioids, which was a key addition to the patient

Table 3
Secondary outcomes

Secondary outcomes	Nonorder set cohort (n = 16)	Order set cohort (n = 19)	*P* value
Median quantity prescribed, tablets	50 (28.5–50)	32 (32–32)	0.099
Mean (SD) quantity used, tablets	13.5 (±11)	13.5 (±8)	0.961
Patients with multimodal therapy	14 (88%)	19 (100%)	0.202
Reported "getting better" at 14 d postop	14 (88%)	14 (74%)	0.415
Reported "can do most things" at 14 d postop	8 (50%)	10 (53%)	0.877
Reported "normal sleep" at 14 d postop	9 (56%)	9 (47%)	0.600
Reported pain regimen was "very effective" at 14 d postop	11 (69%)	14 (74%)	1.00
Reported they knew how to dispose opioids	14 (88%)	18 (95%)	0.582
Requested a refill?	1 (6%)	3 (16%)	0.608
Number of tablets left over (average per patient)	459 (±14) (29 per patient)	370 (±10) (20 per patient)	**0.03**
ER visits within <7 d	0 (0%)	0 (0%)	N/A
On opioids after 1 -y	2 (12%)	1 (5%)	1.0
Given adequate education and expectations?	16 (100%)	17 (89%)	0.339
Allowed to participate in decisions about your pain treatment?	13 (81%)	14 (74%)	0.803

Bold value is statistically significant *P*-value <0.05.

education component of the new multimodal order set. Although the awareness of how to dispose of extra opioid tablets was already high in the nonorder set cohort (88%), 95% of patients in the order set cohort reported knowing how to properly dispose of the opioid.

Before implementation, one of the primary concerns that surgeons voiced about the new order set was that, with the lower default number of tablets prescribed, patients could run out of opioid tablets and have difficulty obtaining a refill if they were still experiencing pain. Refills are logistically difficult for both the patient and the provider for various reasons. To address this concern, the order set included suggested refill e-scripts that were available if requested, to mitigate the potential time burden that could occur if more patients were to require refills. This was helpful for the 3 patients in the order set cohort who requested the refill, whereas over 84% of the order set cohort were adequately treated with the new, lower tablet prescribing default. So, while the order-set resulted in a modest increase in requested refills, the time burden of these refills was mitigated, and the result was a significant drop in the number of leftover opioids in the community.

A central feature of this new multimodal therapy order set is optimizing the use of nonopioid therapy. With acetaminophen and ibuprofen prescribed as scheduled medications rather than "as needed," the benefits of these therapies are maximized with the potential to reduce the need for opioids. Further, the new patient education provides a variety of recommendations for non-pharmacologic interventions for pain such as ice, rest, meditation, mindfulness, and music or art therapy. Specific mindfulness smartphone apps are recommended as well. Despite these additions, there was no change in the number of opioid tablets used between the nonorder set and order set cohorts, and in both groups, the majority of patients reported ice/cold therapy as their only non-pharmacologic intervention.

One of the primary purposes of this study was to examine the effect of multimodal therapy in orthopedic shoulder procedures. Although multimodal therapies for knee and hip are fairly well-documented, evidence of their use in shoulder procedures is limited. One recent trial by Jones et al. examined the outcomes after shoulder arthroplasty in patients randomized to either an opioid-based pain regimen or an opioid-sparing pain regimen that utilized multimodal therapy.[9] Patients in the opioid-sparing group used significantly fewer opioid tablets, discontinued opioids sooner, and had higher levels of satisfaction than patients in the opioid-based group.[9] In our study, it was somewhat surprising that the addition of multimodal therapy in the new order set did not result in a significant change in the number of opioid tablets used. Several factors may have contributed to this finding. First, the small sample size may have been a factor. Second, an appreciable number of multimodal therapies were already in use among the nonorder set patients (88%)—although the order set, quantity limits, and patient education were new, nonopioid therapies for pain have been increasingly employed in the post-operative setting in recent years. Certainly, the addition of the order set did result in 100% of the patients in the order set cohort reporting use of multimodal therapy. However, in the broader context, emphasizing the use of nonopioids as the cornerstone of treatment, rather than an optional adjunct, is an essential theme for patient education that can perhaps reset patient and caregiver expectations for future surgical procedures as well.

Patient satisfaction with a pain regimen is a fundamental, and sometimes overlooked, metric needed to gauge the success of any new regimen. In our study, patient satisfaction was similar in both the order set and nonorder set cohorts, so the implementation of the new order set did not change satisfaction appreciably. Although no differences in satisfaction were noted in our study, the literature does indicate that multimodal approaches to pain control often improve patient satisfaction. As previously mentioned, the study by Jones et al. comparing opioid-based and opioid-sparing regimens after shoulder procedures demonstrated higher patient satisfaction with the opioid-sparing regimens.[9] Similarly, a study by Ilyas et al. examining outcomes after orthopedic hand procedures found that multimodal pain regimens had higher patient satisfaction than opioid-only regimens.[10] This is not unexpected given that opioids often have considerably more adverse effects than other pain control measures such as the combination of acetaminophen and a non-steroidal anti-inflammatory. Although we did not identify an increase in satisfaction, this may be due simply to the small sample size. It is nonetheless reassuring that patient satisfaction did not decrease with the implementation of our multimodal therapy order set.

There are several limitations to this study. First, the small sample size and the nonrandomized nature of the patient groups are significant limitations, as we were using previously collected data. Second, using the patients of different surgeons for the non-order set and order set cohorts could have introduced selection bias as different surgeons can have patient populations that vary significantly in demographics and health status. And related to this, in the nonorder set group, one surgeon performed 15 of the 16 procedures, which could potentially have influenced the outcomes. These provider-related limitations could limit external validity. Third, the nonorder set patients were not provided with any specific educational material about pain and the order set group was provided with material; although this was part of the intervention, this could be considered an additional confounding factor. Finally, the last patient contact occurred 14 days postoperatively, and this may not have allowed sufficient time to fully evaluate the postoperative recovery period. Future randomized, prospective studies could investigate the role of different pharmacologic and nonpharmacologic interventions in reducing the need for opioids in this setting and could also explore longer-term outcomes with the use of multimodal therapy after surgery.

Conclusion

As we continue optimizing the management of pain in the postoperative setting following orthopedic procedures, the shift away from opioids as the primary mechanism for pain control is paramount. Our study demonstrated that the introduction of a multimodal order set for postoperative pain after complex shoulder interventions allowed for a reduction in the amount of opioid prescribed and a reduction in the number of excess opioids remaining in the community

without negatively affecting patient experience or satisfaction.

Disclosure

The authors declare no relevant conflicts of interest or financial relationships.

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