

Opioid Prescription Patterns 90 Days After Arthroscopic Rotator Cuff Repair

A 10-Year National Database Analysis

Wesley Day,* BS, Kevin Tang,* BS, Peter Y. Joo,[†] MD, MPH, Jonathan N. Grauer,[†] MD, Sercan Yalcin,[†] MD, Christopher V. Wilhelm,[†] MD, MHS, and Michael J. Medvecky,^{†‡} MD

Investigation performed at Yale School of Medicine, New Haven, Connecticut, USA

Background: Arthroscopic rotator cuff repair (ARCR) is a common procedure that typically requires opioid prescription for postoperative pain management.

Purpose: To investigate the current prescription patterns and factors influencing 90-day postoperative opioid prescription trends for opioid-naïve patients who underwent ARCR.

Study Design: Case series; Level of evidence, 4.

Methods: Opioid-naïve adult patients who underwent ARCR between January 2010 and September 2020 and had a record of opioid prescriptions during the 90-day postoperative period were identified in the PearlDiver Mariner91 national administrative database. Exclusions included patients with prior shoulder procedures, a history of chronic pain, and opioid prescription records dated earlier than 4 weeks before surgery. Covariates included age group, sex, Elixhauser Comorbidity Index, and prescriber specialty (orthopaedic or nonorthopaedic). The primary outcome—90-day postoperative morphine milligram equivalents (MMEs) prescribed per patient—was compared using univariate and multivariate regression analyses, and 90-day postoperative opioid prescription trends over the 10-year study period were analyzed with linear regression.

Results: In total, 55,345 ARCR cases were identified. The mean \pm SD amount prescribed within the first 90 days was 742.4 \pm 256.5 MMEs, and the median was 487.5 MMEs. Multivariate linear regression analysis predicted higher 90-day postoperative MMEs for female patients and younger patients ($P < .01$ for both). From 2010 to 2020, there was a 66% decrease in mean MME prescribed per patient ($\Delta = 660.4$ MME; $P < .01$), with a mean reduction of 55.1 MME per patient per year. In 2020, the mean 90-day postoperative amount prescribed was 341.1 MME, which is equivalent to 51 tablets of 5-mg oxycodone (Percocet).

Conclusion: Female sex and younger age were predictors of more MME being prescribed after ARCR. While opioid prescriptions following ARCR have substantially decreased over the past decade, the amount prescribed warrants further attention.

Keywords: rotator cuff; opioid epidemic; shoulder; health care utilization

The opioid epidemic has highlighted the demand to address the impact of narcotic prescriptions on society and bring greater attention to this topic.^{4,5,18} Orthopaedic surgeons as a specialty are the third-largest issuer of opioid prescriptions,⁹ exceeded only by pain medicine and physical medicine and rehabilitation. Thus, combined physician and patient education around safe opioid use and prescribing practices in orthopaedics is crucial.

In the field of sports medicine, arthroscopic rotator cuff repair (ARCR) is an increasingly common²⁷ procedure that may be associated with significant postoperative pain and narcotic usage. A meta-analysis analyzing postoperative opioid use after all surgical procedures revealed that female

patients and those with a high school education level (vs college degree or higher) used more postoperative opioids.¹² However, risk factors for increased prescriptions of opioids after ARCR have not yet been defined.

While early postoperative pain control is important for addressing temporary pain and reducing risk of developing chronic pain after surgery,²² the extensive side effect profile and potential for abuse¹⁷ speaks to the continued need to minimize opioid use after surgery.

Over the past decade, health care professionals have given much attention to minimizing narcotic use among patients after surgery.^{3,7,15,19} These physician-led efforts have been complemented by legislative action, such as new state regulations on duration limits and dosage for opioid prescriptions.¹⁴ Maximum prescribed daily opioid dose has been directly associated with the risk of opioid-related overdose death.¹ However, national trends of postoperative

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opioid prescriptions or utilization for many orthopaedic surgical procedures have yet to be tracked.

The purpose of the current study was to analyze 90-day postoperative opioid prescription patterns after ARCR in a large opioid-naïve population to better understand opioid prescription patterns, risk factors for greater opioid prescriptions, and trends over a decade. It is hoped that the study findings will help orthopaedic surgeons better understand current practices, assess for areas of continued improvement, and further optimize this aspect of patient care and counseling.

METHODS

Study Cohort

Data for the current study were sourced from the PearlDiver Mariner91 (PearlDiver Technologies) national administrative claims database, which contains the longitudinal medical and prescription records of >91 million covered patients. This study was exempt from institutional review board approval.

Patients who underwent primary ARCR between January 2010 and September 2020 were identified by Current Procedural Terminology code 29827. Patients were excluded if they were <18 years of age at the time of surgery or did not have opioid prescription records within 90 days after surgery. The 7 Uniform System of Classification codes for opioids (02211, 02212, 02214, 02221, 02222, 02231, and 02232) were used to identify patients with records of opioid prescriptions. The Uniform System of Classification is a North American-specific, hierarchical, drug classification system developed as a standard for pharmaceutical product classification for use by pharmaceutical companies.

Several additional exclusion criteria were applied. For the purpose of this study, we defined opioid-naïve patients as those without a history of chronic opioid use. To create an opioid-naïve study cohort, we excluded patients with opioid prescription records dated earlier than 4 weeks before ARCR. We did not exclude patients who filled opioid prescriptions within 4 weeks of surgery, because patients may fill opioid prescriptions in this time frame for their preoperative pain. Next, patients were excluded if they had chronic pain diagnoses according to the codes of the International Classification of Diseases, Ninth or Tenth Revision. Last, we excluded any patients with Current Procedural Terminology codes involving any other upper

extremity procedures performed on the same day as the primary ARCR surgery.

Study Variables

Information recorded from the PearlDiver database included patient age, sex, Elixhauser Comorbidity Index (ECI; a measure of patient comorbidity burden), and 90-day postoperative opioid prescription trend data, including the total number of prescription records and total morphine milligram equivalents (MMEs) prescribed. We chose the 90-day postoperative interval because the majority of postoperative opioid prescriptions in an opioid-naïve population is within this interval. In addition, prescriber specialty (orthopaedic vs nonorthopaedic) was identified from the opioid prescription records.

For comparison purposes, the study population was categorized by age group (40-49, 50-59, 60-69, and 70-79 years), sex, ECI (≤ 2 or > 2), and prescriber specialty. Patients aged <40 years and >80 years were excluded from the age group analysis owing to the comparatively minimal patient volume. We also evaluated the year-by-year trend in mean 90-day postoperative MME prescribed per patient between 2010 and 2020.

Data Analysis

The mean, standard deviation, and median 90-day total postoperative MME for patients were abstracted in each age group, sex, ECI, and prescriber specialty category. Comparing means and standard deviations with median values for the study cohort allowed for greater insight into the skewing of the distribution of prescribed MME. Univariate analysis of variance (ANOVA) was performed to test for differences in MME prescribed per patient within each covariate of interest (age group, sex, ECI, and prescriber specialty).

Multivariate linear regression was performed to evaluate the “excess” MMEs prescribed to patients within each age group, sex, ECI, and prescriber specialty cohort. Excess MME was defined as the mean amount of MME that a cohort was prescribed beyond the amount prescribed to the referent cohort of the same variable. Using the Bonferroni correction, the alpha value for our analyses was established at .010, with the threshold for significance set at $P < .010$. Finally, the 10-year trend of mean MMEs prescribed per patient was fitted with a trendline, and regression analysis was performed to assess the goodness of fit. All statistical analyses were performed in the PearlDiver Bellwether software.

†Address correspondence to Michael J. Medvecky, MD, Department of Orthopaedics and Rehabilitation, Yale School of Medicine, 47 College St, New Haven, CT 06510, USA (email: michael.medvecky@yale.edu) (Twitter: @MichaelMedveck1).

*Albert Einstein College of Medicine, Bronx, New York, USA.

†Department of Orthopaedics and Rehabilitation, Yale School of Medicine, New Haven, Connecticut, USA.

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Ethical approval for this study was waived by Yale University (protocol No. 2000028988).

TABLE 1
Characteristics of the Study Population (N = 55,345)^a

Age, y, mean ± SD	58.77 ± 10.5
Sex, No.	
Female	23,528
Male	31,817
ECI, mean ± SD	1.87 ± 2.0
Opioid prescriptions written per patient	
Mean	1.92
Median	1
MME prescribed per patient	
Mean ± SD	742.4 ± 256.5
Median	487.5

^aECI, Elixhauser Comorbidity Index; MME, morphine milligram equivalent.

TABLE 2
MME of Commonly Prescribed Oral Opioids for Postoperative Pain^a

Opioid Prescription	MME
30 tablets	
15-mg codeine	67.5
5-mg hydrocodone (Vicodin)	150
5-mg oxycodone (Percocet)	225
2-mg hydromorphone (Dilaudid)	240
10-mg morphine (Kadian, Avinza)	300
5-mg oxymorphone (Opana)	450

^aMME, morphine milligram equivalent.

RESULTS

Study Cohort and MME Prescribed

The study query yielded 55,345 patients who had records of opioid prescriptions within 90 days after the index ARCR and met all inclusion criteria. The mean ± SD age of the patients was 58.8 ± 10.5, and female patients made up 43% of the study cohort. Demographic and prescription-related information is shown in Table 1. Common postoperative opioid prescription regimens are converted to MMEs in Table 2.

The distribution of MMEs prescribed per patient is shown in Figure 1. Prescriptions <400 MMEs were administered to 42.6% of patients, whereas 15.4% were prescribed >1000 MMEs within 90 days after ARCR from all prescriber sources.

Predictors of Greater Opioid Prescription

According to univariate analysis (ANOVA), significantly greater amounts of opioids were prescribed within 90 days of surgery for patients who were younger (incremental by age group; $P < .010$) and female (765.1 vs 725.6 MME for male; $P < .010$) and had less morbidity burden (754.1 MME for ECI ≤2 vs 713.6 MME for ECI >2; $P < .010$) (Table 3).

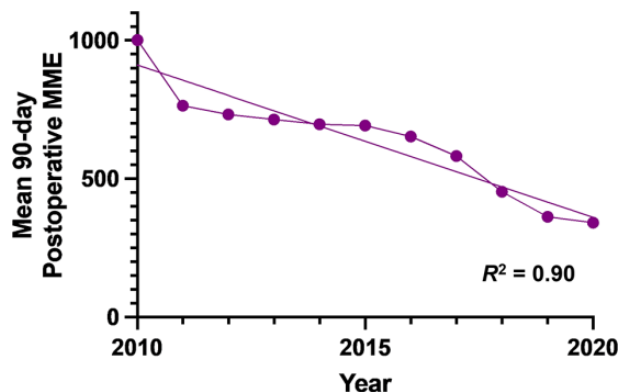


Figure 1. Percentage of patients who underwent arthroscopic rotator cuff repair was categorized by total 90-day postoperative morphine milligram equivalents (MMEs) prescribed.

Results of the multivariate analysis indicated that younger age and female sex were predictive of more excess MMEs being prescribed. When compared with patients 70 to 79 years of age, those aged 60 to 69 years had an excess prescription of 80.4 MMEs; those aged 50 to 59 years, 165.2 MMEs; and those aged 40 to 49 years, 201.5 MMEs ($P < .010$). Female sex was associated with an excess opioid prescription of 45.6 MMEs ($P < .010$) (Table 3).

Prescription Trends for MMEs During the Study Period

Yearly trend analysis for 90-day postoperative prescriptions for MME over the decade of the analysis showed a downtrend of 55.1 MMEs per patient per year (Figure 2). In fact, the mean MMEs prescribed per patient decreased by 66% from 2010 (1001.5 MMEs) to 2020 (341.1 MMEs).

DISCUSSION

The current study included 55,345 opioid-naïve patients who underwent ARCR and had postoperative prescription records. To our knowledge, this is the largest study to track opioid prescription trends after isolated ARCR in patients over the 90-day postoperative window and the first to identify demographic risk factors for increased opioid prescription amounts in this population. The median total 90-day postoperative opioid amount prescribed was 487.5 MMEs, the equivalent of 72 tablets of 5-mg Percocet (oxycodone). For reference, another database study of opioid-naïve, privately insured patients undergoing common orthopaedic procedures between 2015 and 2016 found that the median total 90-day postoperative opioid amount prescribed was 450 MME, the equivalent of 67 tablets of 5-mg Percocet.²⁵ These findings are similar to the results of the current study.

Notably, we found that the mean total 90-day postoperative prescription was 742.4 MME, the equivalent of 110 tablets of 5-mg Percocet. The considerable discrepancy between the mean value and the median (487.5 MME) may

TABLE 3
Univariate and Multivariate Analyses of Opioid Prescriptions Within 90 Days After ARCR^a

Predictor	No.	Univariate Analysis		Multivariate Analysis	
		MME, Mean ± SD	P	Excess MME, ^b Mean ± SD	P
Age group, y			<.010		<.010
40-49	7897	825.9 ± 1103.6		201.5 ± 16.3	
50-59	17,527	791.4 ± 1304.9		165.2 ± 14.3	
60-69	18,521	706.2 ± 889.5		80.4 ± 14.2	
70-79	9307	629.4 ± 703.2		Reference	
Sex			<.010		<.010
Male	31,817	725.6 ± 1074.0		Reference	
Female	23,528	765.1 ± 1026.9		45.6 ± 9.1	
ECI			<.010		.085
≤2	39,294	754.1 ± 1073.1		17.2 ± 10.0	
>2	16,051	713.6 ± 1006.3		Reference	
Prescriber specialty			.021		.032
Orthopaedic	44,658	659.2 ± 597.7		42.4 ± 19.7	
Nonorthopaedic	3045	726.5 ± 1604.7		Reference	

^aBold *P* values indicate statistical significance (*P* < .010). ARCR, arthroscopic rotator cuff repair; ECI, Elixhauser Comorbidity Index; MME, morphine milligram equivalent.

^bEstimated excess MMEs prescribed over 90-day postoperative period as compared with the reference group of the same variable.

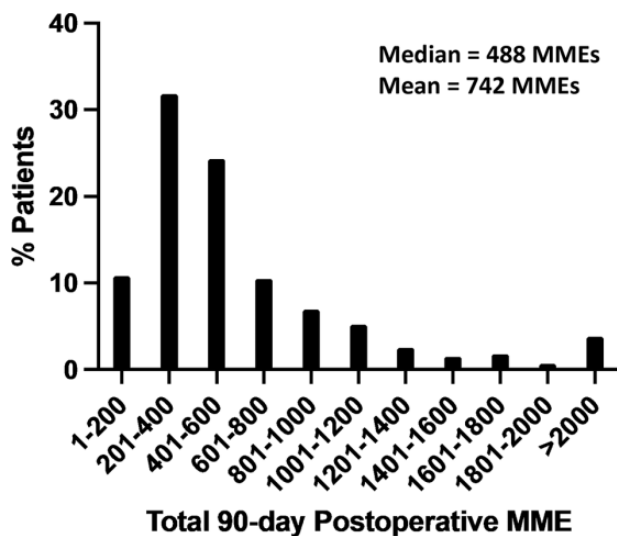


Figure 2. Yearly trends in 90-day postoperative prescriptions for morphine milligram equivalents (MMEs) after arthroscopic rotator cuff repair, January 2010 to September 2020. Equation of line: $y = -55.1x + 911$.

be attributed to outlier patients with particularly large prescriptions.

We found that female patients were at greater risk for being prescribed more opioids (45.6 MMEs more vs male patients; *P* < .010). This finding supplements the literature, which reports that women suffer more opioid-related overdoses yearly as compared with men²⁶ and are more likely to use prescription opioids.²⁰ This finding may support the findings of Leroux et al,¹³ who reported that female sex carried an increased risk of long-term opioid use after elective shoulder surgery, given that longer and higher-

dosage opioid prescriptions may be associated with a decreased likelihood of discontinuation in opioid-naïve patients.²¹ Younger patients were also found to be at greater risk for being prescribed more opioids. This trend was consistent among the decade-based age groups that we studied; on average, patients in each subsequently younger age group are prescribed increasingly more total MMEs in their 90-day postoperative course.

Over the 10-year study period, the mean 90-day postoperative opioid prescription amount per patient declined, from the equivalent of 148 tablets of 5-mg Percocet in 2010 to 51 tablets in 2020. This may represent the effects of increased attention to this topic over the past decade.^{3,6,7,11,15,16,23} There has been discussion around reducing postoperative opioid use by implementing multimodal analgesic therapy,¹⁶ local-regional blocks,¹¹ physical therapy,⁷ and preoperative counseling,^{6,23} among other strategies. The PROSPECT study (Procedure-Specific Pain Management),²⁴ the first to establish evidence-based procedure-specific postoperative pain management guidelines for rotator cuff repair surgery, recommended that opioids should be used only as rescue analgesia in the postoperative course. While Williams et al²⁹ found that patients who used preoperative opioids for pain control tended to use more postoperative opioid prescriptions after ARCR, their study did not stratify for the dosage or duration of the preoperative opioids taken.

It has been reported that 9.8% of opioid-naïve patients fill an unusually elevated number of prescriptions after ARCR (described as ≥6 prescriptions filled within 2 years of surgery), and this figure soars to 18.6% when prior opioid users are included.^{6,8} Noting the rampant issues with narcotic use,¹⁸ it is important for physicians to understand the risk factors for the overprescription and misuse of opioids after procedures such as ARCR so that they become better stewards of opioids. The past decade has seen legislative

and judicial enforcements in efforts to minimize physician opioid-prescribing practices. By the end of 2019, 39 states in the United States had imposed regulations on the duration limit for an opioid prescription, with the most common limit being 7 days.¹⁴ In addition, 14 states had imposed regulations on prescription opioid dosage, ranging from 30 to 120 daily maximum MMEs. In 2018, the United States developed a first-of-its-kind initiative to stop opioid abuse, which included utilizing a Department of Justice litigation unit to advance the prosecution of “corrupt or criminally negligent doctors, pharmacies, and distributors.”²⁸ A combination of legal restrictions as well as fear of legal repercussions among physicians may be contributing to the declining opioid prescription trend.

Broadly, there is still much room for improvement in reducing opioid prescriptions among orthopaedic surgeons: Kim et al¹⁰ reported that orthopaedic surgeons still prescribe 3 times the amount of narcotics that end up being consumed by patients undergoing various upper extremity surgical procedures. Awareness of the likely overprescription patterns of providers and recognition of the underutilization of the opioids prescribed may assist in reducing the risks and cost of postoperative pain control.

Limitations

The limitations of the current study are consistent with other administrative database studies in that the data are subject to potential administrative error in coding and extraction.³⁰ Furthermore, patient-specific data (particularly of outliers) cannot be assessed. Finally, while the current study tracked opioid prescriptions through claims, it did not track patient consumption of opioids. However, postoperative opioid prescriptions, especially the duration of prescription, have been shown to directly correlate with opioid misuse (defined as dependence, abuse, or overdose).²

CONCLUSION

There has been tremendous progress in reducing opioid prescriptions after ARCR from 2010 to 2020. While the large amount of MMEs being prescribed to opioid-naïve patients after ARCR has gone down significantly over the 10 years studied, opioid overdose deaths continue to increase rapidly in the United States. Orthopaedic surgeons should be aware that younger age and female sex may be risk factors for overprescription of narcotics after ARCR. While adequate postoperative pain control is necessary, orthopaedic surgeons should be enacting strategies to minimize the need to prescribe opioids after surgery. Further studies into demographic, socioeconomic, and medical professional factors for overprescription and misuse of opioids are warranted to guide physician stewardship of narcotics.

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