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Predictors of Discharge Home Without Opioids After Cardiac Surgery: A Multicenter Analysis

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ABSTRACT

BACKGROUND Whether all patients will require an opioid prescription after cardiac surgery is unknown. We performed a multicenter analysis to identify patient predictors of not receiving an opioid prescription at the time of discharge home after cardiac surgery.

METHODS Opioid-naïve patients undergoing coronary artery bypass grafting and/or valve surgery through a sternotomy at 10 centers from January to December 2019 were identified retrospectively from a prospectively maintained data set. Opioid-naïve was defined as not taking opioids at the time of admission. The primary outcome was discharge without an opioid prescription. Mixed-effects logistic regression was performed to identify predictors of discharge without an opioid prescription, and postdischarge opioid prescribing was monitored to assess patient tolerance of discharge without an opioid prescription.

RESULTS Among 1924 eligible opioid-naïve patients, mean age was 64 ± 11 years, and 25% were women. In total, 28% of all patients were discharged without an opioid prescription. On multivariable analysis, older age, longer length of hospital stay, and undergoing surgery during the last 3 months of the study were independent predictors of discharge without an opioid prescription, whereas depression, non-Black and non-White race, and using more opioid pills on the day before discharge were independent predictors of receiving an opioid prescription. Among patients discharged without an opioid prescription, 1.8% (10 of 547) were subsequently prescribed an opioid.

CONCLUSIONS Discharging select patients without an opioid prescription after cardiac surgery appears well tolerated, with a low incidence of postdischarge opioid prescriptions. Increasing the number of patients discharged without an opioid prescription may be an area for quality improvement.

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The opioid epidemic is a nationally recognized public health emergency, with 130 American deaths each day due to opioid overdose.[1,2] One source of opioid dependence is from postoperative opioid prescriptions, and prescription size has been shown to be predictive of new persistent opioid use.[3-5]

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Recent studies focusing on postoperative opioid prescribing have attempted to identify the optimal number of opioid pills to prescribe after a surgical procedure to control postoperative pain, while minimizing the risk of developing new persistent opioid use and opioid diversion into the surrounding community.[6-8] The efforts to decrease postoperative opioid prescribing in cardiac surgery have led to the establishment of evidence-based opioid prescribing guidelines.[8]

However, whether every patient actually needs an opioid prescription after a cardiac operation remains unclear. It is plausible that the postoperative pain of a subset of patients could be adequately controlled with nonopioid analgesia. Identification of these patients could enable prescribers to minimize unnecessary risk of new persistent opioid use and further limit unnecessary opioids in the community.

Alternatively, it is possible that most patients will require an opioid prescription after a cardiac operation. In addition, we may subsequently see increased rates of opioids prescribed after discharge but before the follow-up appointment for patients not initially prescribed an opioid at the time of discharge. Identification of patients who may not need an opioid prescription at discharge may lead to less opioid prescribing. In addition, determining whether these patients subsequently request opioid prescriptions at follow-up visits or through telephone calls is essential to characterize whether discharging patients without an opioid prescription is a safe and well-tolerated practice.

This study used opioid prescribing data from a statewide quality improvement collaborative to compare patient characteristics between those who did vs did not receive an opioid prescription at the time of discharge to identify independent predictors of not needing an opioid prescription. In addition, the immediate post-discharge period was assessed to determine whether patients not receiving a prescription tolerated this practice. This study was undertaken to determine whether decreasing opioid prescriptions at discharge is a feasible quality improvement target.

MATERIAL AND METHODS

This study was deemed exempt from review by the University of Michigan Institutional Review Board (HUM00156194).

DATA SOURCE. Our primary data sets were the Michigan component of The Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database (ACSD) and the Adult Cardiac Surgery Opioid Prescribing Project data set from the Michigan Society of Thoracic and Cardiovascular Surgeons Quality Collaborative (MSTCVS-QC), which consisted of retrospective analysis of a prospectively maintained data set. The MSTCVS-QC consists of all 33 nonfederal centers in Michigan performing cardiac surgery. Among these, 10 centers participated in an opioid prescribing quality improvement project that included a team of data managers who collected unique opioid use variables through a medical record review, including preoperative opioid use, opioid use on the day before discharge, and data regarding opioid prescription on discharge and at follow-up appointments.

Standard clinical data, including patient demographics, comorbidities, operative data, and postoperative outcomes, were collected from the STS ACSD and linked to MSTCVS-QC opioid data by unique record identification numbers that were further verified with dates of surgery and discharge.

PATIENT POPULATION. Opioid-naïve patients undergoing isolated coronary artery bypass grafting (CABG) and/or valve surgery through a median sternotomy from January through December 2019 at 10 hospitals in Michigan were identified. Opioid-naïve was defined as not taking an opioid at the time of admission for surgery. All opioid use data were first converted to oral morphine equivalents and then quantified in 5-mg oxycodone pills.

From 3650 patients undergoing cardiac surgery through a median sternotomy, sequential exclusions were applied to patients if they were an operative death ($n = 153$), had a postoperative length of stay >30 days ($n = 74$), were discharged to a location other than home ($n = 612$) (eg, a skilled nursing facility or subacute rehabilitation facility), thus not requiring an opioid prescription for transfer, underwent redo sternotomy ($n = 268$), underwent operations other than CABG/valve ($n = 124$), had known opioid use at time of admission ($n = 397$), did not have a documented race ($n = 70$), or were missing preoperative risk factor values ($n = 28$) (Supplemental Figure).

STATISTICAL ANALYSIS. The primary outcome was not receiving an opioid prescription at discharge. Continuous variables are reported as mean ± SD and categorical variables as percentages. For univariate analysis, demographics, operative data, and postoperative outcome data were compared between those patients who did and did not receive an opioid prescription. For multivariable analysis, a mixed-effects logistic regression model was created with the dependent variable of not receiving a prescription at discharge with covariates including patient characteristics and operative data as fixed effects, as well as accounting for the random effect of individual hospitals. Data are reported as odds ratios with 95% CIs.

TABLE 1 Patient Characteristics for All Opioid-Naïve Patients Undergoing Median Sternotomy at 10 Centers in Michigan Between January and December 2019

Characteristics	Total Population (N = 1924)	Received Prescription at Discharge (n = 1377)	No Opioid Prescription at Discharge (n = 547)	*P* Value
Age, y	64 ± 11	62 ± 11	67 ± 10	<.001
Female sex	478 (25)	323 (23)	155 (28)	.03
Race				.009
White	1717 (89)	1210 (88)	507 (93)	
Black	150 (8)	121 (9)	29 (5)	
Non-White, non-Black	57 (3)	46 (3)	11 (2)	
Smoking status				<.001
Never smoker	762 (40)	525 (38)	237 (43)	
Former smoker	819 (43)	576 (42)	243 (44)	
Current smoker	343 (18)	276 (20)	67 (12)	
Diabetes	720 (27)	534 (39)	186 (34)	.05
Cancer within last 5 years	112 (6)	69 (5)	43 (8)	.02
History of stroke	417 (22)	296 (21)	121 (22)	.76
Hypertension	1629 (85)	1177 (85)	452 (83)	.12
Peripheral vascular disease	216 (11)	163 (12)	53 (10)	.18
Heart failure	703 (37)	461 (33)	242 (44)	<.001
Depression	391 (20)	294 (21)	97 (18)	.08
Operative acuity				.61
Elective	1169 (61)	836 (61)	333 (61)	
Urgent	709 (37)	511 (37)	198 (36)	
Emergent	46 (2)	30 (2)	16 (3)	
Type of operation				<.001
CABG	1040 (54)	796 (58)	244 (45)	
Valve	649 (34)	449 (33)	200 (37)	
Combined CABG/valve	235 (12)	132 (10)	103 (19)	
Length of stay, d	6.7 ± 3.2	6.2 ± 2.6	7.9 ± 4.2	<.001
Complications	750 (39)	464 (34)	286 (52)	<.001

Data are presented as n (%) or mean ± SD. CABG, coronary artery bypass grafting.

Statistical significance was defined as a *P* value <.05. All analyses were performed in Stata 16.0 software (StataCorp LLC).

RESULTS

Among 1924 total patients, the mean age was 64 ± 11 years, 25% were women, and 89% were White (Table 1). Isolated CABG was performed in slightly over half, 54% (n = 1040), isolated valve operations were performed in 34% (n = 649), and the remaining 12% (n = 235) underwent combined CABG/valve procedures. The rate of any complication was 39% (n = 750), and mean length of stay was 6.7 ± 3.2 days. The mean number of pills taken on the day before discharge was 1.8 ± 2.8. Nearly half (47% [n = 909]) of patients did not take any opioids on the day before discharge, and among these patients, 415 (46%) still received an opioid prescription at discharge, while 494 (54%) did not. Overall, 28% (547 of 1924) did not receive an opioid prescription at time of discharge (Figure 1).

In univariate analysis, a higher proportion of patients with older age, White race, nonsmokers, patients with heart failure, undergoing valve or CABG/valve surgery, longer length of stay, having a complication, and taking

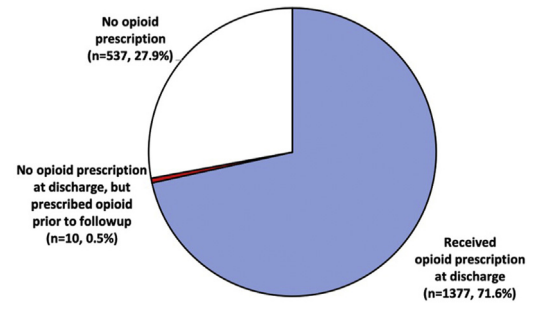

FIGURE 1 Distribution of patients who did and did not receive an opioid prescription at discharge and those who did not receive an opioid prescription at discharge but were prescribed an opioid before follow-up.

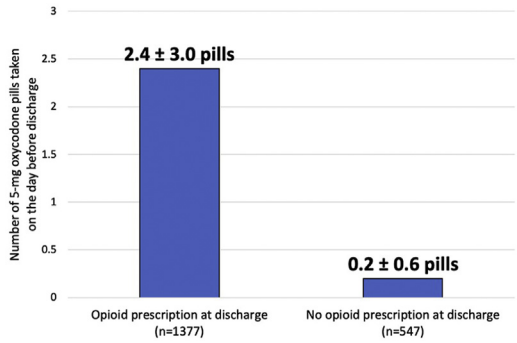

FIGURE 2 Comparison of number of opioid pills used on the day before discharge between patients who did and did not receive an opioid prescription. Values are reported as mean ± SD.

fewer opioid pills on the day before discharge did not receive an opioid prescription on discharge (Table 1). Patients who received an opioid prescription on discharge used a mean 2.4 ± 3.0 pills on the day before discharge, whereas patients who did not receive a prescription took a mean 0.2 ± 0.6 pills on the day before discharge ($P < .001$) (Figure 2).

In multivariable analysis, older age, longer length of stay, and being discharged during the fourth quarter of the study period (October through December) were independent predictors of no opioid prescription at discharge. Conversely, non-White and non-Black race, history of depression, and taking more opioid pills on the day before discharge were independent predictors of being discharged with an opioid prescription (Table 2). Patients were significantly more likely to be discharged without an opioid prescription as the year progressed. Whereas 25% (114 of 458) of patients who underwent surgery during the first quarter (January-March) were discharged without an opioid prescription, 34% (165 of 485) of patients in the fourth quarter (October-December) were discharged without an opioid prescription (P-trend <.001) (Figure 3).

Finally, of the 547 patients who did not receive an opioid at discharge, 1.8% (n = 10) were prescribed an opioid after discharge from the hospital and before their 30-day follow-up appointment (Figure 1).

TABLE 2 Independent Predictors of No Opioid Prescription at Discharge[a]

Predictor	No.	Odds Ratio	95% CI	*P* Value
Older age, per 10 years	1924	1.24	1.08-1.43	.003
Race				
White	1717	Ref		
Black	150	0.98	0.53-1.82	.96
Other	57	0.43	0.19-0.96	.04
Depression	391	0.64	0.45-0.92	.02
Hospital length of stay, per day	1924	1.11	1.05-1.18	<.001
Each additional opioid pill taken on the day before discharge	1924	0.22	0.17-0.28	<.001
Quarter of discharge				<.001
Quarter 1 (Jan-Mar)	458	Ref	…	
Quarter 2 (Apr-Jun)	510	1.06	0.72-1.57	
Quarter 3 (Jul-Sept)	471	1.40	0.95-2.07	
Quarter 4 (Oct-Dec)	485	1.89	1.29-2.79	

[a]The full multivariable logistic regression model had a Hosmer-Lemeshow goodness-of-fit test statistic of $P < .001$.

COMMENT

In this multicenter quality improvement project examining predictors of discharge home without an opioid prescription in opioid-naïve patients who underwent a CABG and/or valve operation, we report that older age and longer length of stay were independent predictors of discharge without an opioid prescription, whereas history of depression, race other than White or Black, and taking more opioid pills on the day before discharge were independent predictors of receiving an opioid prescription. In addition, discharge without an opioid prescription appears well tolerated, as only <2% of patients subsequently required an opioid prescription after their discharge and before their 30-day follow-up appointment. Collectively, these findings suggest that not every patient requires an opioid prescription after cardiac surgery and that discharge without an opioid prescription in this select group is well tolerated.

Several studies have sought to identify predictors of new persistent opioid use after surgical procedures, which have included opioid prescription size as well as a number of patient characteristics.[5,9-11] Notably, younger age, history of depression, and higher opioid use on the day before discharge were identified as risk factors for new persistent use[9-13] and were also independent predictors of receiving an opioid prescription in this study. These findings may identify a targeted audience for counseling on postoperative pain management strategies and postoperative opioid use. Several comorbidities that were previously reported as risk factors for new persistent use had no association with receiving an opioid prescription at discharge, including tobacco use, congestive heart failure, or diabetes.[9-12]

While race other than Black or White was an independent predictor of receiving an opioid prescription in this study, race has only intermittently been reported as a risk factor for new persistent opioid use.[4] Non-White patients have been shown to experience significant bias from prescribers, and their pain is less likely to be believed and treated by providers.[14] Because of this confounder, the clinical impact of race, and specifically in this study of non-White and non-Black patients being

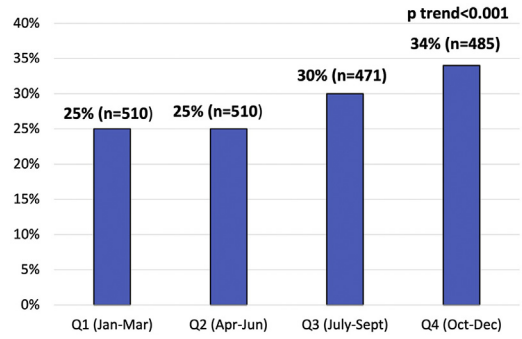

FIGURE 3 Percentage of patients discharged home without an opioid prescription by 3-month periods, depicting the trend of prescribing patterns throughout the study period. (Q, quarter.)

more likely to receive an opioid prescription, is not clear. However, it is important to consider the racial disparities non-White patients experience in the treatment of postsurgical pain.

Interestingly, longer length of stay was associated with new persistent use in previous studies,[4,5] yet was predictive of not receiving a prescription at discharge in our study. This finding may be because the studies of new persistent opioid use only included patients who initially filled an opioid prescription at discharge. In contrast, the current study found longer length of stay to be associated with not receiving an opioid prescription at discharge. These same patients would not be captured in the new persistent use studies, because those studies only included patients who did receive a prescription.

One of the independent predictors of discharge without an opioid prescription was being discharged during October through December of the study period. During the time of this study (January-December 2019), one of the primary quality improvement goals of the MSTCVS-QC was decreasing opioid prescribing after a cardiothoracic surgical procedure. The decrease in opioid prescribing throughout the course of the year was likely reflective of this quality improvement effort and the realities and importance of collaborative learning, as well as increased awareness regarding potential adverse sequelae of postoperative opioid prescribing. Future studies could evaluate time-related trends over a longer period of time to assess whether the proportion of patients discharged without an opioid prescription has continued to increase, both in Michigan and nationally.

Previous studies have reported discharge without an opioid prescription among 10% to 80% of patients, depending on the type of procedure.[14-16] One large retrospective review of more than 4000 patients undergoing elective cardiac operation between 2014 and 2017 found that 1132 (27.4%) were discharged without an opioid prescription.[17] This percentage was similar to the rates of discharge without an opioid prescription in January through June of our study period and is likely reflective of prescribing rates in cardiac surgery before increased scrutiny of prescribing policies and the establishment of prescribing guidelines.[8]

Prior studies support our conclusion that discharge without an opioid prescription is well tolerated. A quality improvement effort to limit unnecessary opioid prescriptions after gynecologic surgical procedures successfully increased the rate of discharge without a prescription from 17.3% to 76.9% over the study period, while patient phone calls and refill rates remained consistent.[14] Going further, several investigators have stopped prescribing opioids entirely after surgical procedures. Moo and colleagues[18] performed a prospective study in which the standard prescription after lumpectomy with sentinel lymph node biopsy was changed from an opioid and nonsteroidal anti-inflammatory drug to acetaminophen and a nonsteroidal anti-inflammatory drug. The subsequent rate of prescribing an opioid within 7 days of surgery was only 2% (5 of 251),[18] which is nearly identical in the current study.

Through an Enhanced Recovery After Surgery (ERAS) protocol for patients undergoing mastectomy, all but 1 patient did not receive an opioid prescription on discharge, and it was later found that this patient was likely a chronic opioid user. This led the authors to claim that "mastectomy is no longer an indication for postoperative opioid prescription at discharge."[19] Further, prior work reviewing nearly 1000 patients undergoing general surgery found that prescribing a decreased number or even no opioids after a surgical procedure did not negatively impact patient satisfaction scores.[20] In cardiac surgery, we have previously demonstrated that postoperative pain scores remained the same despite implementing opioid prescribing guidelines that resulted in decreased opioid prescribing and opioid use.[8]

Although there has been significant progress in promoting more responsible postoperative opioid prescribing practices across all types of surgery, the primary focus within cardiac surgery has been to decrease the amount of opioids prescribed, with much less attention on eliminating unnecessary opioid prescriptions. Our group published postoperative opioid prescribing recommendations after cardiac surgery, based on the amount of opioids patients used on the day before discharge.[8] These guidelines recommend that patients who take no opioids on the day before discharge receive an opioid prescription for 0 to 4 pills.[8] In our study population, 415 patients did not take any opioids on the day before discharge yet still received an opioid prescription. One may consider whether these opioid prescriptions were truly necessary for patient pain relief, or

whether they were prescribed "just in case" the patient would later need an opioid prescription. The data in this study support that many patients do well without an opioid prescription, and thus, we may reconsider providing patients with an opioid prescription "just in case" they may need it. Using these data to implement statewide efforts to limit unnecessary opioid prescribing may be an important role for a quality improvement collaborative such as the MSTCVS-QC and similar organizations in other states.

LIMITATIONS. Our study has several limitations. First, this is a retrospective analysis of an observational cohort study. However, objective prescribing data recorded in the electronic medical record is not subject to time-related bias.

Second, during the course of the study period, there was a statewide effort to reduce opioid prescribing, which did affect prescribing throughout the year. While this effort likely contributed to the increase in the proportion of patients discharged without an opioid prescription over the course of the study period,[8] these efforts likely did not impact the predictors of not receiving a prescription, and different periods of time were accounted for in multivariable analysis.

Next, while this study focuses on patient factors that predict discharge without an opioid prescription, there are likely clinician factors that also impact prescribing, which is not captured in this study. However, these clinician factors are likely ubiquitous across many centers and will persist until there are widely adopted standardized postoperative prescribing guidelines.

Finally, perioperative pain management strategies employed postoperatively during the patient's hospital stay were not standardized across the 10 participating centers, which could contribute to differences in prescribing. However, some differences in pain management practices are expected across different cardiac surgery centers, and the statewide effort to reduce prescribing did also aim to standardize postoperative opioid prescribing quantities. In addition, the inclusion of data from 10 centers may improve the generalizability of these findings.

These limitations notwithstanding, these data provide important insights into postoperative opioid prescribing. Relevant to policymakers, our results suggest that greater emphasis can be placed on patients not receiving an opioid prescription at discharge in postoperative opioid prescribing guidelines. Relevant to physicians and prescribers, increased awareness that discharge without an opioid prescription is well tolerated in the appropriate patient may help to limit unnecessary opioid prescriptions. Finally, this study may provide patients with reassurance that postoperative pain can be well managed with nonopioid adjuncts when they are at home and that not all patients will require an opioid prescription after cardiac surgery.

CONCLUSION. These data suggest that not all patients require an opioid prescription after cardiac surgery and that discharge without an opioid prescription is well tolerated in select patients. Cardiac surgery providers should consider shifting focus from the amount of opioid to prescribe to patients to instead determine which patients do not need any opioid prescription at discharge.

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