Retrospective Study

Factors Predicting Chronic Opioid Use after Orthopedic Surgical Procedures

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Background: Opioid abuse has been an increasing problem since the 1990s. With over 47,000 opioid related deaths recorded in 2017 alone, concerns have been raised regarding the dangers of introducing opioids perioperatively to patients undergoing major surgeries.

Objectives: The present study proposes to examine the frequency, amount, and trends in post-operative opioid consumption in patients undergoing orthopedic surgical procedures.

Study Design: This was a randomized, retrospective questionnaire-based study.

Setting: Patients who underwent any type of orthopedic surgery at the University of Pennsylvania Presbyterian Hospital from 1/1/2018 to 3/12/2019 were randomly selected and called during the summer of 2019.

Methods: In this retrospective questionnaire-based study, 828 patients were called by telephone in the summer of 2019. These patients were asked a variety of questions involving opioid consumption behavior post-surgery. The study ended after receiving responses from 200 patients.

Results: Nineteen (9.5%) patients reported positively for experiencing euphoria while taking opioids post-surgery. Of the 200 patients contacted, 6 patients (3%) reported switching to marijuana instead of opioids. Thirty-eight (19%) patients preferred to take no opioids at all post-surgery, and one patient was found to have given their prescription to a family member or friend. Twenty-one patients (10.5%) were found to have been taking opioids for non-severe pain. Blacks and whites were the most common racial demographics, making up 84 and 109 of the totals, respectively. The odds ratios for all of the predictors showed that the relative risk for opioid misuse was higher for black patients than white patients (OR = 3.034). There was no relationship between the intra- and post-operative opioid administration and long-term opioid misuse.

Limitations: Patients are self-selected and had the option to opt out of the study when contacted. Some patients may not have been available to answer the phone when our study was being conducted. This study was only conducted for orthopedic patients and for patients who received surgery at the University of Pennsylvania Presbyterian Hospital, thus affecting the demographics for our research.

Conclusions: Prescription opioid misuse is more common among the black population. The total opioid consumption is frequently lower than the quantity prescribed. Patients frequently use opioids even though they feel that pain is insufficient to deserve such an intervention. Euphoria is experienced by a significant number of patients taking prescription opioids Often patients do not take any opioids, although they had prescriptions.

Key words: Opioids, post-operative pain, misuse, abuse

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Opioid abuse has been rapidly increasing since the early 1990s (1). Prior to the 1990s, opioid painkillers were primarily prescribed to cancer patients (1). However, in 1991 pharmaceutical companies began to downplay the long-term negative consequences of opioids. This led to a sharp increase in opioid prescriptions for noncancer related pain (1). This first wave of the opioid epidemic was followed by a

second wave in 2010, where heroin became a cheaper and easier to obtain alternative for opioids (2). In 2013, use of synthetic opioids began to increase as well, one of which being the drug fentanyl, a very common anesthesia medication given to a majority of patients undergoing surgery (2). Deaths from opioid abuse have become increasingly common among Americans. In 2017, over 47,000 deaths were recorded due to prescription and nonprescription opioid overdose, and deaths are projected to reach nearly 82,000 by 2025 (3). The opioid epidemic has also created a large economic burden for the country, as increased healthcare and substance abuse treatment has cost the United States upwards of $78 billion a year (4).

With the opioid epidemic becoming a major public health concern, studies have been conducted to determine the likely contributing factors. Concerns have been raised about the dangers of introducing opioids perioperatively to an opioid naive patient. One study in 2016 found that male and elderly patients (over 50 years of age) with histories of substance abuse had a greater risk of becoming opioid dependent post-surgery where opioids were introduced (5). Another study concluded that a very small proportion of women become opioid dependent following cesarean delivery (6). Studies have also been conducted to determine alternatives to opioid administration in an attempt to reduce the amount of prescription painkillers given to patients. A study in 2016 concluded that the administration of preoperative gabapentin reduced the total opioid consumption 24 hours following surgery (7).

However, many of these studies fall short in predicting the patient factors that are likely to contribute to opioid abuse. Furthermore, much of the literature currently published relies on the amount of prescriptions filled by the patient as the opioid abuse indicator, giving no evidence of whether the patient was actually taking the medication and to what degree. The current study aims at directly determining the extent to which patients consumed their postoperative opioid prescriptions. As evidence suggests, even one tablet of a particular opioid may lead to continued use of opioids. In this study, we planned to examine whether the perioperative introduction of opioids has any effect on the patients' immediate, intermediate, or long-term postoperative seeking of opioids.

Methods

After obtaining the Institutional Review Board's approval, patient and procedural data from 1/1/2018 to 3/12/2019 of all patients undergoing surgical procedures was obtained from the billing office. Patients who underwent any type of orthopedic surgery at the University of Pennsylvania Presbyterian Hospital were randomly selected and called over the phone for participation in our questionnaire-based study. Any children under the age of 18 were excluded from the sample. A total of 828 patients were called during the hours of 9:00 AM to 5:00 PM and the study was stopped after obtaining a total of 200 responses. The types of procedures for each patient were categorized into one of 19 major classifications.

Patients who answered the phone were questioned for approximately 10 to 15 minutes. Verbal consent was obtained from each of the patients participating in the study prior to any questions being asked. The questionnaire form was filled in real time. Preliminary demographics, intraoperative opioid administration, and postoperative opioid prescriptions were extracted from the electronic medical records. The questions included opioid consumption patterns during the first week post-surgery and up to 6 months following surgery. Patients were also asked about any euphoria they experienced under the influence of opioids, whether they took opioids for nonsevere or no pain, and whether the patient gave their opioid supplies to any friends or family members. Furthermore, any other pain management methods employed by the patient, such as marijuana consumption, were noted and recorded. This study relied on the patient to remember opioid consumption behavior during the time period up to 6 months following surgery.

All data regarding opioid prescriptions and the patient's opioid consumption pattern (pill count) were converted to the respective Morphine Milligram Equivalent (MME) for comparison purposes. Conversion factors for intravenous and prescription opioids were taken from the center for Medicare and Medicaid services website. For patient prescriptions, the maximum amount prescribed was used when calculating average MME/day.

All data analysis was completed using IBM SPSS Statistics (Version 25.0. Armonk, NY) for Macintosh.

Means and standard deviations were calculated for prescribed opioid MME/day as well as consumed MME/day per procedure (Fig. 1). Any procedures with less than 4 patients were excluded from the summary boxplot. All data were analyzed using binary logistic regressions with a *P* value of 0.05 being considered as significant in these comparisons. Statistical analysis was

done for different cohorts of demographics as well as perioperative indicators to determine whether opioid misuse was occurring (Table 1).

Results

Of the 828 patients called for this study, a total of 200 responses were recorded. These 200 responses were then grouped into one of 19 procedural categories. Table 2 summarizes all of the demographics for the 200 patients screened. All patients were grouped by gender, ethnicity, age range, and body mass index (BMI) range. Each of the patients were grouped into 4 different racial categories. Blacks and whites were the most common racial demographics, making up 42% and 54.5% of the totals respectively. Each of the patients contacted were also asked of their education levels. Patient education levels were grouped into one of 8 different categories and reported in Table 2 as well.

Averages and standard deviations for patient prescriptions were also calculated for each of the procedural categories. These were then compared against the averages and standard deviations for the patient

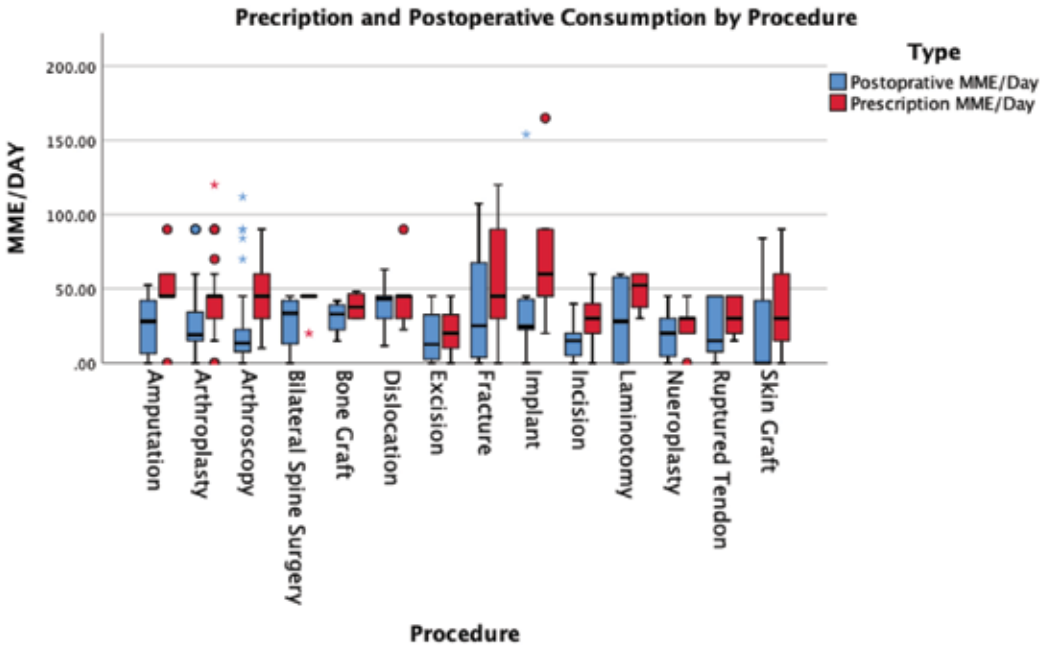

Fig. 1. *Mean and standard deviations for prescription and consumption opioid MME/day for each procedure.*

Table 1. *Summary statistics.*

								95% C.I. for Odds Ratio	
		B	S.E.	Wald	df	Sig.	Odds Ratio	Lower	Upper
Step 1[a]	Gender	.649	.549	1.400	1	.237	1.914	.653	5.608
	Age at Time of Surgery	.000	.022	.000	1	.989	1.000	.957	1.044
	Race	1.110	.534	4.318	1	.038	3.034	1.065	8.640
	Euphoric	.592	.786	.566	1	.451	1.807	.387	8.438
	Intraoperative Opioid MME	.005	.018	.086	1	.770	1.005	.971	1.041
	Prescription MME Day	.013	.009	1.900	1	.168	1.013	.995	1.032
	Constant	-3.987	1.433	7.736	1	.005	.019		

[a] Variable(s) entered on Step 1: Gender, AgeatTimeofSurgery, Race, Euphoric, IntraopOpioidMME, PrescriptionMMEDay

Table 2. *Demographics of study.*

		Count
Gender	Male	103
	Female	97
Ethnicity	White	109
	Black	84
	Asian	3
	Hispanic or Latino	4
Age Range	< 20	1
	21 – 30	17
	31 – 40	40
	41 – 50	36
	51 – 60	58
	61 – 70	48
BMI Range	< 18.5	1
	18.5 – 24.9	38
	25.0 – 29.9	58
	30.0	103
Highest Education Level	No formal education credential	8
	High school diploma or equivalent	51
	Some college, no degree	36
	Postsecondary nondegree award	1
	Associate's degree	13
	Bachelor's degree	50
	Master's degree	20
	Doctoral or professional degree	21
Type of Surgery		
Amputation		5
Arthroplasty		61
Arthroplasty		50
Bilateral Spine Surgery		7
Bone Graft		3
Craniectomy		1
Dislocation		5
Excision		4
Fasciectomy		1
Fracture		13
Implant		9
Incision		9
Joint Aspiration		1
Laminotomy		4
Neuroplasty		9
Ruptured Tendon		5
Skin Graft		3
Sympathectomy		1
Tenotomy		2

consumption pattern per day (MME/day) for each procedure. Fig. 1 summarizes these results in a multi boxplot format, however those surgeries with less than 4 patients were excluded from the diagram. As seen from graph, the average patient consumption pattern for all of the procedural categories shown was as much or less than the prescribed MME/day.

We also screened our patients to determine whether opioids were being consumed for pain that was not reported as severe. Twenty-one patients out of the 200 total (10.5%) were found to have been taking opioids for nonsevere pain. For analytical purposes, we characterized any behavior involving the consumption of opioids for non-severe or no pain as opioid misuse.

Statistical analysis was used to determine which predictors may affect the patient's likeliness to misuse opioids. A binary logistic regression was done for different predictors that may influence opioid misuse. Each of the predictors that were included in the model are seen in Table 1. Only patients who identified as black or white were used in the model, due to low responses from other ethnicities. The intraoperative opioid MME administered during surgery as well as the prescription MME/day for each of the patients were used as factors to predict opioid misuse as well. Lastly, patients were screened to determine whether they reported any feelings of euphoria while consuming the prescribed opioids, of which 19 patients reported positively (9.5%). This was also used as a predictor in our model.

Although the model itself was not considered significant ($P = 0.140$), it is worth noting that the race predictor did report a significant finding ($P = 0.038$). The odds ratios for all of the predictors are also reported in Table 1. As shown, the relative risk for opioid misuse was higher for black patients than white patients (OR = 3.034, 95% Confidence Interval, 1.065 to 8.640).

Other forms of pain management such as marijuana were found to be effective for patients post-surgery, with 6 patients out of the 200 reporting to have switched to marijuana instead of opioids (3%). Although it is uncertain in what form these patients used marijuana (whether medicinally or recreationally), all patients who reported to have been self-prescribing marijuana instead of opioids experienced significant pain relief (self-reported by patients). Furthermore, 38 patients preferred to take no opioids at all post-surgery (19%), and only one patient was found to have given their prescription to a family member or friend.

Discussion

As defined by the Federation of State Medical Boards, opioid misuse "encompasses all uses of a prescription medication other than those that are directed by a clinician." This may include taking a dose when it is not necessary, taking a larger dose than instructed, or taking the dose in a different manner than prescribed, such as through injection or snorting (8). This is distinct from Opioid Use Disorder (OUD), which is also referred to as opioid addiction. OUD or opioid addiction is characterized by a powerful, compulsive urge to use opioids when not medically required, which may result in significant impairment or distress (9,10). Given these definitions, for the purposes of our study, any patient reported to have consumed opioids for non-severe pain was characterized as misusing opioids.

Our study suggests that prescription opioid misuse is more common among the black population. Furthermore, comparison between prescription opioid amounts and patient consumption patterns reveal that the total opioid consumption is frequently lower than the quantity prescribed. Results from our questionnaire suggest that patients frequently use opioids even though they feel that their pain is insufficient to deserve such an intervention (10.5%). Euphoria is also experienced by a significant number of patients taking prescription opioids (9.5%). It is also important to note that some patients recourse to drugs such as marijuana to relieve pain (3%). Furthermore, patients rarely offer their personal prescription opioids to friends and family members (0.5%) and often times, patients opt to not take any opioids, although they had prescriptions (19%).

Although, in terms of percentages these above observations are small, it is important to extrapolate these figures to total national opioid prescriptions and the public health hazard posed by such conduct. In addition, one should bear in mind that patients may be hesitant to disclose such aspects of opioid use/misuse, even in a confidential research setting and as a result the real magnitude of problem at national level is likely to be significantly more than revealed in our study.

As mentioned in the results, Table 1 summarizes the statistics from the binary logistic regression conducted to predict opioid misuse. While the model was not significant, it is important to note that the race predictor used in the model did result in a significant finding, indicating that blacks are more likely to misuse opioids than whites. Although this cannot be considered a significant finding due the model's overall insignificance, its implications could be useful for guiding future opioid prescription behavior. Furthermore, it is worthy to note that these findings are in contrast to those concluded from a study conducted by Unick et al (11) who found that whites, women, and middle-aged individuals had the largest increase in prescription related opioid overdoses since 2007. While our study did not aim at predicting opioid related overdoses, we believe that opioid misuse is a major contributor to opioid overdose.

For all types of surgeries, the average prescription was higher than the average MME consumed per day. These results support those findings found by Makary et al (12) which conclude that over prescription is a major contributor to the opioid epidemic.

Our study indicates that patients undergoing orthopedic surgeries often use opioids even though they feel that pain is insufficient to deserve such an approach. Similar findings were reported by Shah et al (13). Their retrospective database study included a large number of managed care plans and was representative of the U.S. commercially insured population. They noticed that, in cancer-free adults who received a prescription for opioid pain relievers, the likelihood of chronic opioid use increased with each additional day of medication supplied starting with the third day, with the sharpest increases in chronic opioid use observed after the fifth and thirty-first day on therapy. Other factors that contributed to chronic use included a second prescription or refill, 700 morphine milligram equivalents cumulative dose, and an initial 10- or 30-day supply. Similarly, Harbaugh et al (14) found persistent opioid use in 4.8% of children who filled a postoperative opioid prescription.

Research suggests that cannabis should not necessarily be considered an optimal choice as a drug for pain management (15). However, the general absence of CBD in what is used "medically," and the methodological challenges in conducting research are some of the proposed challenges in making such recommendations (16).

A study found that the prevalence rate for borrowing someone's prescription medication was 5% to 51.9% and for lending prescription medication to someone else was 6% to 22.9%. Sharing primarily occurs between family members, friends, and acquaintances (17). Both recreational and nonrecreational sharing is seen. In another study (18), a total of 20.7% (weighted percentage) reported ever having shared opioid medications with another person. This is primarily done to help the other person manage pain.

Euphoria is especially common with fentanyl, fentanyl analogs, and other new synthetic opioids (19). Currently, fentanyl is one of the most commonly abused/misused opioid drugs in the USA (20). In our study, 19 patients (9.5%) reported in the affirmative on the question of experiencing euphoria.

Thirty-eight patients (19%) in our study preferred to take no opioids at all post-surgery, even though they had prescriptions. This indicates that we fail to recognize the patients who would take/require/benefit from such a prescription. While it is likely that many patients may have preferred to tolerate pain for the fear of addiction after appropriate consumption, there could be other reasons why patients may have preferred not to take opioids. One of which is opioid induced constipation (OIC). OIC is one of the most common side effects of opioid consumption and is experienced by more than 40% of patients taking opioids for chronic non-cancer pain (21). As the amount of prescription opioids increase, it is likely that more patients are dissuaded from using such opioids out of fear from such gastrointestinal symptoms (22). Along with OIC, urinary retention is also a major factor that may dissuade patients from consuming prescription opioids (23).

There were also a few limitations to the scope of our study. Firstly, patients are self-selected and had the option to opt out of the study when contacted. Furthermore, some patients may not have been available to answer the phone when our study was being conducted. This is the reason for our 24.2% turnover rate when considering the patients screened and those called (200 out of 826). This resulted in our study not being entirely random, since particular demographics may be more likely to answer and opt in to the study. Secondly, this study was only conducted for orthopedic patients and for patients who received surgery at the University of Pennsylvania Presbyterian Hospital, thus further affecting the demographics for our research.

Future directions include incorporating more patients from other types of surgeries as well as considering a greater number of patients for our predictive model. Screening patients in person rather than over the phone may also help provide more accurate data as well as a greater total number of patents. Perhaps talking with patients prior to surgery could also help mitigate possible opioid misuse or over prescription.

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