



Self-reported cannabis use is not associated with greater opioid use in elective hand surgery patients

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Received: 25 May 2022 / Accepted: 15 June 2022

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Abstract

Background The purpose of this study was to examine the influence of preoperative marijuana use on postoperative opioid use during the first three postoperative days (POD 1–3) after surgery, and on expectations of pain control, resiliency, and quality-of-life scores.

Methods All patients presenting to a single institution undergoing elective hand or upper extremity outpatient surgery were asked to complete pre- and postoperative questionnaires. Preoperative questionnaires collected information on demographics, marijuana use, tobacco use, procedure type, self-assessed health, pain control expectations, and EuroQol-5D (EQ-5D) scores. At the first postoperative visit, patients self-reported opioid consumption from POD 1–3. Multivariate linear regression analysis was used to determine which patient characteristics were predictive of greater postoperative opioid consumption during POD 1–3.

Results Self-reported marijuana users were younger, less healthy, and more likely to use tobacco compared to non-users. Marijuana users and non-users were comparable in their use of pain medication (including non-opioids), rates of chronic pain diagnoses, and self-reported pain tolerance. EQ-5D scores were lower in marijuana users than non-users (0.64 vs. 0.72). Marijuana users and non-users were prescribed comparable quantities of opioids during the first 14 days after surgery (176 ± 148 vs 115 ± 87). Multiple linear regression analysis revealed that lower preoperative EQ-5D scores, rather than marijuana use, were associated with increased opioid consumption during POD 1–3.

Conclusions Preoperative marijuana use was not independently associated with increased opioid use during POD 1–3 after elective hand and upper extremity surgery; instead, an association with lower preoperative EQ-5D scores was identified.

Level of Evidence II, prospective cohort study.

Keywords Marijuana · EQ-5D · Narcotics · Pain management · Cannabinoid

Introduction

Baseline preoperative opioid use in hand surgery clinic patients is as high as 17.4% [1]. Cannabis has recently been legalized for medical use in 29 states and the District of Columbia; this captures 63% of the US population [2, 3]. Cannabis contains two primary cannabinoids: tetrahydrocannabinol (THC) produces the psychoactive effects sought after by recreational users, whereas cannabidiol (CBD) has mood-altering and anti-inflammatory effects; both appear to contribute analgesic effects [4–6]. Opioid agonists elicit analgesia by binding to G-protein coupled receptors in the central and peripheral nervous system to cause cellular hyperpolarization. In contrast to the trivial adverse event profile of cannabis (dizziness, dry mouth, fatigue) [7],

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opioids are also known to cause gastrointestinal effects (constipation, nausea, vomiting), urinary retention, weight gain, respiratory depression, hyperalgesia, and endocrinopathies (e.g., decreased libido, hypogonadism, osteoporosis) [8]. As public sentiment shifts regarding cannabis use, there has been an increased interest in understanding the beneficial and harmful effects of marijuana use on surgical patients, especially as an alternative or an adjunct to perioperative opioid use [9–11].

A meta-analysis of preclinical studies demonstrated that cannabis co-administration decreases the median effective dose of morphine and codeine [10]; however, studies on the effect of cannabinoids specific to orthopedic patients have shown mixed results [12–16]. Madden et al. reviewed 21 primary studies that examined the effect of cannabis as an analgesic in orthopedic patients and found that cannabinoids were effective as an intervention for pain management when compared to a placebo [15]. Additionally, one case–control study of 243 hip and knee arthroplasty patients demonstrated decreased total opioid use with synthetic cannabinoid co-administration [13]. However, in a case–control study of 71 total knee arthroplasty patients, Jennings et al. found that patients who reported preoperative cannabis use had similar inpatient opioid use and patient-reported outcome scores as those who did not [12]. Despite the growing interest in alternatives to opioid use for postoperative pain control, to our knowledge, there are no published studies on the effect of cannabis use on postoperative opioid consumption on outpatient hand surgery patients.

The purpose of this study is to examine the influence of patient-reported preoperative marijuana use on postoperative opioid use in the first 3 days after surgery. We hypothesized that preoperative marijuana use is not associated with increased postoperative opioid use. Secondary endpoints included the effect of preoperative marijuana use on patient expectations of pain control, resiliency scores, and quality-of-life scores.

Materials and methods

The study was an Institutional Review Board-approved prospective cohort study conducted at a single institution in the USA. All patients provided written informed consent to participate in the study and were free to withdraw at any time. Adult patients (> 18 years) seen in the Hand and Upper Extremity Division at our institution and underwent elective outpatient surgery on the elbow, forearm, wrist, or hand from January 2020 to April 2020 were offered participation. Patients that agreed to participate were asked to complete preoperative and postoperative questionnaires. We used a multimodal pain regimen including nerve block, acetaminophen, NSAIDs, and gabapentinoids as indicated.

The preoperative questionnaire collected patient demographics including age at the time of surgery, sex, tobacco use, and chronic pain disorder diagnosis. The planned surgery was designated as either a “bony” or “soft tissue” procedure. The demographics portion of the questionnaire contained the question “Do you use marijuana (recreational or medicinal)?” with a box to check “Yes” or “No.” Patients who did not answer this question were not included in the study. The preoperative questionnaire also evaluated patient’s preoperative opioid use including medication used, dosage, duration, and frequency. Opioid medication doses were converted into Opioid Oral Morphine Milligram Equivalents (MME) using the conversion table published on the Centers for Medicare and Medicaid Services (CMS) Web site [17]. Patients were asked to assess their pain tolerance on a scale from 0 to 10 with 10 being the highest pain tolerance. Patient also assessed their health on a 0–100 scale with a score of 100 representing the best health imaginable. The preoperative survey included the EuroQol Group 5D survey (EQ-5D), which assessed self-care, activity, pain, and anxiety/depression [18]. The EQ-5D survey is a multi-attribute utility instrument with scores of “0” representing a state equivalent to being dead and a score of “1” representing full health [19]. The preoperative survey also included the Brief Resiliency Scale (BRS), which measures patient’s ability to bounce back or cope with adverse conditions [20]. The BRS scores range from “1 to 5” with a score of “5” representing high resilience. Finally, patients were asked about their pain from the diagnosis for which they were undergoing surgery on a 0–10 scale, with “10” being the worst possible pain. Patients were asked to assess the amount of pain they expected to have postoperatively on a 0–10 scale, how much pain they felt was acceptable postoperatively, and their expectations on the number of pills and duration of postoperative opioids.

At the first postoperative visit, between 1 and 3 weeks postoperatively, patients were administered a second questionnaire. The post-op questionnaire assessed the type and number of opioid pills taken on each of the first 3 postoperative days (POD).

Two-sided Fisher’s exact tests and Welch’s two-sample *t* test were used to compare groups where appropriate. Multivariate linear regression analysis was used to determine which patient characteristics were predictive of greater postoperative opioid use between POD 1 and 3.

Results

In total, 252 patients completed the preoperative survey including the question about marijuana use. The average age of this cohort was 51.7 years. Of the 252 patients, 93 (36.9%) completed the postoperative survey. The average

age of this cohort was 53 years. In the groups with complete preoperative and postoperative data, 11.5% and 10.8% of the patients reported marijuana use, respectively. Due to the low number of patients with complete postoperative data resulting from COVID-19-related restrictions, the preoperative dataset is also presented for preoperative opioid use and patient's expectations of postoperative pain medication. This analysis was also performed separately on the cohort with complete postoperative data and is presented in the tables.

Self-reported marijuana users were younger than non-users (38.8 vs. 54.7 years, $P=0.004$). There was reported concomitant tobacco use in 50% of marijuana users and 18.1% of non-users ($P=0.03$). The self-assessed health was poorer in marijuana users compared to non-users (59.3 vs. 79.4, $P=0.01$). There was no statistically significant difference in the type of procedure performed on each group (Table 1).

Only one patient (3.4%) out of the 29 marijuana users in the cohort with complete preoperative data reported daily preoperative opioid use. Forty patients (17.9%) in the non-users group reported daily opioid use. Statistical testing could not be conducted due to only 1 patient using

preoperative opioids in the marijuana users group. There was no statistically significant difference in the rates of any pain medication use, including non-opioids, between groups. Groups were similar in their rates of chronic pain diagnosis and self-reported pain tolerance (Table 2).

The mean EQ-5D score was lower among marijuana users compared to non-users (0.64 vs. 0.72, $P=0.07$). The mean BRS score and pain from the preoperative hand surgery diagnosis were similar between groups. There was no statistically significant difference in patients' expectations of the amount of postoperative pain and the duration and amount of pain medication prescribed postoperatively (Table 3).

The quantity of opioids prescribed for the first 14 days after surgery did not differ between marijuana users and non-users (176 ± 148 vs. 115 ± 87 MME, $P=0.23$). Multiple linear regression analysis of predictors for the number of opioid pills taken during POD 1–3 revealed that self-reported marijuana use was not significantly associated with a higher consumption of opioids in the immediate postoperative period. However, lower preoperative EQ-5D scores were associated with greater opioid consumption on POD 1–3 ($P=0.03$) (Table 4).

Table 1 Demographics for pre-op only and pre- and post-op cohorts

Demographics	Pre-op only			Pre- and post-op		
	Non-users ($N=223$)	Pre-op MJ ¹ users ($N=29$)	P value	Non-users ($N=83$)	Pre-op MJ users ($N=10$)	P value
Age at surgery, years	53.0 \pm 17.3	41.3 \pm 16.8	0.002	54.7 \pm 16.5	38.8 \pm 13.0	0.004
Procedure: Soft	55.2% (123)	48.3% (14)	0.55	49.4% (41)	20.0% (2)	0.1
Tobacco use: Yes	17.5% (39)	44.8% (13)	0.002	18.1% (15)	50.0% (5)	0.03
Self-assessed health	79.3 \pm 17.4	69.9 \pm 19.5	0.02	79.4 \pm 16.9	59.3 \pm 19.4	0.01

Mean (SD) or N (%) is reported. Bold values indicate statistical significance

¹ MJ, Marijuana

Table 2 Opioid use and pain for pre-op only and pre- and post-op cohorts

	Pre-op only			Pre- and post-op		
	Non-users ($N=223$)	Pre-op MJ ¹ users ($N=29$)	P value	Non-users ($N=83$)	Pre-op MJ users ($N=10$)	P value
Currently take pain medication	28.7% (64)	13.8% (4)	0.12	24.1% (20)	0% (0)	0.11
Daily pre-op opioid use, MME	53.6 \pm 47.4	30 \pm 0 ²	NA	39.6 \pm 34.6	–	NA
Duration of pre-op opioid use, days	1013 \pm 1157	1645 \pm 2319	0.77	463 \pm 531	–	NA
Chronic pain diagnosis	19.3% (43)	20.7% (6)	0.80	16.9% (14)	30.0% (3)	0.36
Self-reported pain tolerance	6.8 \pm 2.4	7.1 \pm 2.4	0.52	6.7 \pm 2.2	7.1 \pm 2.9	0.69

Mean (SD) or N (%) is reported. Bold values indicate statistical significance

¹ MJ, Marijuana

²Data only available for one patient

Table 3 Preoperative pain expectations

Pain expectations	Non-users (<i>N</i> =223)	Pre-op MJ ¹ users (<i>N</i> =29)	<i>P</i> value
Pain from pre-op hand surgery diagnosis (0–10)	5.1 ± 3.1	5.2 ± 3.6	0.81
Expected post-op pain (0–10)	5.6 ± 2.6	5.9 ± 2.4	0.61
Acceptable predicted post-op pain (0–10)	4.0 ± 2.0	3.9 ± 1.8	0.83
Expected duration of post-op pain medication requirement, days	5.6 ± 4.2	6.8 ± 5.5	0.28
Too many pills expectation, pills	31.9 ± 87.9	28.6 ± 13.9	0.69
Too few pills expectation, pills	10.8 ± 9.8	13.0 ± 8.9	0.28
Expected prescription duration, days	6.3 ± 4.4	7.5 ± 5.3	0.28
Pre-op BRS ²	3.0 ± 0.5	3.1 ± 0.3	0.28
Pre-op EQ-5D ³	0.72 ± 0.16	0.64 ± 0.22	0.07

Bold values indicate statistical significance

¹ MJ, Marijuana

² BRS, Brief Resiliency Score

³ EQ-5D, EuroQol Group 5D

Table 4 Multiple linear regression of preoperative predictors for total narcotics pills taken between postoperative days 1 and 3

Preoperative predictor	Estimate	95% CI ¹	<i>P</i> value
Intercept	14.4	(5.77, 23.1)	< 0.01
Age	−0.04	−0.11, 0.03)	0.27
Tobacco use: Yes	1.42	(−1.49, 4.32)	0.33
Marijuana use: Yes	0.23	(−3.59, 4.04)	0.91
Self-assessed health	0.02	(−0.08, 0.11)	0.76
14-day prescribed MME ²	0.01	(0.00, 0.03)	0.13
EQ-5D ³ score	−11.6	(−21.9, −1.36)	0.03

Bold values indicate statistical significance

¹ CI, confidence interval

² MME, morphine milligram equivalents

³ EQ-5D, EuroQol Group 5D

Discussion

Baseline preoperative opioid use in hand surgery clinic patients is as high as 17.4% and is associated with poorer patient-reported health and upper extremity function [1]. Expanding legalization of marijuana has warranted the study of marijuana use in surgical patients, especially as an alternative or adjunct to perioperative opioid use [9–11]. In a study of Medicaid patients, Shi et al. found that marijuana legalization did not influence schedule II opioid prescriptions (e.g., fentanyl, oxycodone, morphine, hydrocodone), but it was associated with reduced schedule III opioid prescriptions (e.g., codeine) [21]. Despite the growing interest in alternatives to opioids for postoperative pain control, to our knowledge, no prior studies have

examined the effect of cannabis use on postoperative opioid consumption in outpatient hand surgery patients.

In our study, multiple linear regression analysis revealed no association between preoperative marijuana use and greater opioid consumption during POD 1–3 (*P*=0.93). Additionally, there was a non-significant trend toward marijuana users being prescribed more opioids during the first 14 days after surgery (*P*=0.23). Jennings et al. conducted a case–control study of total knee arthroplasty patients and found that patients who reported preoperative cannabis use had similar inpatient opioid use and patient-reported outcome scores to non-users [12]. These results contrast with those of Bhashyam et al., who conducted a retrospective cohort study of 500 trauma patients and found that patients who self-reported prior marijuana use consumed more opioids for a longer duration postoperatively compared to non-users [16]. Conversely, Madden et al. reviewed 21 primary studies that examined the effect of cannabis as an analgesic in orthopedic patients and found that cannabinoids were effective as an intervention for pain management [15]. Additionally, a case–control study of hip and knee arthroplasty patients demonstrated decreased total opioid use with co-administration of synthetic cannabinoids [13]. The findings of the present study add to the growing controversy on the effect of cannabis use on perioperative opioid use in orthopedic surgery patients.

In this study, 11.5% of patients evaluated preoperatively for elective hand surgery self-reported marijuana use. Marijuana users were younger compared to non-users; yet, they had poorer self-assessed health compared to non-users. Additionally, marijuana users were more likely to use tobacco products than non-users. Goesling et al. performed a retrospective cohort study of 426 patients and found that tobacco smokers had greater pain severity, pain interference,

and depressive symptoms compared to non-smokers [22]. Neither tobacco nor marijuana use was predictive of greater opioid consumption during POD 1–3 in our multivariate analysis. Only one patient who reported marijuana use in the preoperative cohort used opioids daily preoperatively (3.4%) compared to 40 patients in the non-users group (17.9%). While statistical analysis to compare mean daily preoperative opioid consumption was not possible, this finding may suggest that the marijuana users were consuming cannabis instead of opioids. Post hoc power analysis revealed that 145 patients would be needed in the marijuana users group to have 80% power to detect a difference.

Lower EQ-5D scores were independently associated with greater opioid consumption during POD 1–3 on multivariate regression analysis ($P=0.03$). In our preoperative cohort, non-users trended toward having greater EQ-5D scores compared to marijuana users; however, this did not reach statistical significance ($P=0.07$). Post hoc power analysis revealed that we had 69.2% power to detect a difference in preoperative EQ-5D scores between marijuana users and non-users; this study would have required 39 patients in the marijuana users group to have 80% power. In a study of 54 patients with carpal tunnel syndrome (CTS), Nunez et al. found that depression and misinterpretation of nociceptive signals were responsible for 39% of the variation in pain perception related to CTS [23]. Ring et al. administered the Disability of the Hand and Shoulder (DASH) questionnaires to 235 hand surgery patients and found that depression was associated with lower DASH scores [24]. The relationship between EQ-5D scores and opioid use after surgery in our study may result from the EQ-5D capturing the effects of depression. Short et al. found that the EQ-5D is an effective screening tool for depression [25]. In a review of studies on opioid use and depression, Sullivan et al. found that depressed patients are twice as likely to become long-term opioid users [26]. Several studies have identified relationships between poor surgical outcomes and depression, opioid use, tobacco use, and marijuana use [22, 24, 27, 28]. These findings suggest that patients with these risk factors may benefit from additional preoperative counseling or access to mental health or addiction assistance resources.

There are several limitations of the study. Patients retrospectively recorded the number and type of opioids they used during POD 1–3 instead of prospectively recording them in a journal (recall bias). Similarly, our study relied on patients to self-report their preoperative marijuana use. Rates of marijuana use in our study may be subject to under-reporting, given a lower prevalence compared to statistics for the state of Florida in recent years (10.8% vs. 16.7%) [29]. While a urine drug screen would have provided a more accurate assessment of marijuana use, it is not part of the standard preoperative evaluation and may have negatively impacted patient–physician relationships. Furthermore, the

reliance on patients to be honest historians more closely reflects clinical practice. Although the impact of marijuana use was the focus of this study, other variables not assessed in this study have varying degrees of influence on the outcomes we assessed, such as surgical technique, tourniquet time, pre-surgical education, and use of regional anesthesia. Finally, 63% of the patients that completed the preoperative survey did not complete the postoperative survey. During the study period, several patients chose to postpone their elective surgeries or forgo postoperative visits due to the COVID-19 pandemic and associated restrictions.

Despite its limitations, our study contributes to the body of literature by demonstrating the relationship between marijuana and opioid use following outpatient hand surgery. Given the increasing prevalence of marijuana use in the USA, it is imperative that surgeons be able to counsel their patients on the effect of marijuana use on their postoperative recovery. The effect of marijuana use on hand surgery patients certainly merits further research. For now, we suggest that patients presenting with substance use be screened for concomitant depression to facilitate effective treatment and counseling to optimize their surgical outcomes.

Funding This study received no outside funding.

Declarations

Conflict of interest Dr. Wright is a consultant and receives royalties from Exactech, Inc. Dr. King is a consultant for Exactech, Inc. and LinkBio Corp. The other authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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