# Postoperative Pain Management Is Influenced by Previous Cannabis Use in Neurosurgical Patients

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## ABSTRACT

**BACKGROUND:** Cannabis use for medical and recreational purposes is growing. Cannabis may have drug-drug interactions for managing pain, anxiety, and seizures. The research regarding cannabis use in patients with craniotomy surgeries is sparse and often conducted in states where cannabis use is legal. This study compared 24-hour postoperative craniotomy pain levels in patients who reported cannabis use in a state where cannabis is not yet legal. **METHODS:** This is an observational prospective, nonrandomized, pilot study of postoperative craniotomy patients. Patients were consented and given a one-time self-report questionnaire regarding postoperative pain, pain management method, type of pain medication used at home (including cannabis), route of administration, and frequency of use. Subjects scored pain on both the numeric rating scale and the visual analog scale. Demographic data were collected from the electronic medical record. **RESULTS:** Forty-five patients with a mean age of 57 years, 62% female, participated in this study. There were 33% who reported previous cannabis use. One-way analysis of variance showed a significant difference in the mean postoperative pain scores for the cannabis users (4.58) and nonusers (3.89; $P = .0056$). There was no significant difference between age ($P = .1894$) and adequacy of pain control ($P = .6584$) between users and nonusers. **CONCLUSION:** In this pilot study, a one-time survey in critical care on the sensitive topic of cannabis use is feasible and seems to generate honest responses. One-third of patients reported home use of cannabis in a state where cannabis is illegal.

**Key Words:** cannabinoids, cannabis, craniotomy, marijuana, nursing, pain control, pain perception, postoperative, surgery

The use of cannabis as both a medicinal and recreational drug is growing.[1–3] Cannabis use crosses all age, sex, race, and socioeconomic barriers.[4,5] In conjunction with word of mouth, Internet technology may have fueled the increase in use of cannabis as a medical supplement to relieve pain. Little is known about previous cannabis use impacting pain alleviation during an acute hospitalization when the patient stops using cannabis. This pilot study aims to assess postoperative pain in the neuroscience intensive care unit (NSICU) setting with patients who report previous use of cannabis, in comparison with similar patients who do not report cannabis use. The pilot study used self-reports and electronic health records to assess pain levels in the NSICU population after a craniotomy surgery.

## Background

Postoperative pain is a common experience for patients who have had a craniotomy.[6,7] The pain may be caused by intracranial pathophysiology (pressure) or surgical trauma. The management and treatment of pain is part of the regular standard of care provided to patients by nurses and clinicians. Pain can be treated with medications as well as nonpharmacologic agents such as music and meditation.[8] There is some evidence that inhaled cannabis and oral cannabis may help relieve chronic pain.[9] In a recent survey,

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80% of surgical patients felt that cannabis, in some form, would be beneficial in pain relief.[9]

Cannabis use is becoming more common as treatments in a variety of neurological patients. It is used in epilepsy patients for antiepileptic drug properties, as well as in movement disorders such as Parkinson disease, Tourette syndrome, and Huntington disease to reduce spontaneous muscle activity.[10,11] Cannabis use is also reported to have analgesic effects. The exact mechanism is not fully understood, but cannabis comes from the plant *Cannabis sativa L.* and is made up of cannabinoids that are C21 compounds. There are 66 different cannabinoids that come from the *C. sativa* plant, and they interact with CB1 and CB2 receptors found in human body. The CB1 receptors found in the sensory neurons and spinal cord are thought to be responsible for the analgesic effects of cannabis.[10,12] The 2 most commonly known cannabinoids are delta-9-tetrahydrocannabinol (THC), a psychoactive cannabinoid, and cannabidiol (CBD), a nonpsychoactive cannabinoid.[12] Cannabidiol is now legal in all 50 states without a prescription.[13,14]

It is important to note that cannabis can come in plant or synthetic, manufactured by humans, forms. Nabilone is one form of synthetic cannabis that has been approved to dispense with a medical prescription but can be much more potent than natural cannabis.[15] Adverse events that have been reported include tachycardia, agitation and irritability, drowsiness, hallucinations, delusions, hypertension, nausea, confusion, dizziness, vertigo, chest pain, and acute kidney injury.[15] One study found that there was no difference in postoperative pain control in patients who received codeine versus nabilone.[16] However, another study in the bariatric population showed that cannabis users received more opioids postoperatively (47 vs 37 mg) when compared with nonusers.[17] Similarly, in a 2018 study assessing pain post trauma in cannabis users versus nonusers, the cannabis users reported significantly higher pain scores and higher opioid consumption after trauma.[18]

A craniotomy is a surgical procedure in which part of the skull is removed to access intracranial contents or brain tissue.[19] Craniotomies are often not regarded as being painful surgeries,[20] but patients do experience pain postoperatively, and their pain regimen must be a balance between adequate control and appropriate wakefulness for frequent neurological assessment to monitor for complications.[21] In our NSICU, standard of care for a craniotomy includes a direct transfer from the operating room to the NSICU. Intravenous medications (antiemetics and narcotics) are administered for postoperative nausea, vomiting, and pain management. Overnight, hourly neurological examinations and a computed tomography (CT) scan are conducted. If the CT is clear and no neurological changes occur, transfer orders for patients to go to a lower level of care occur the next morning. The purpose of this study is to compare 24-hour postoperative craniotomy pain levels in patients who report previous cannabis use, at least once 30 days before their surgery, as compared with those who do not. To our knowledge, this study will be the first to compare reports of postoperative pain tolerance in an NSICU setting, when considering previous cannabis use.

> Cannabis use affects pain control and 33% of patients used some form or cannabis.

## Methods

This was a prospective, nonrandomized, observational pilot study of postoperative craniotomy patients in an NSICU. Pain level and pain medicine administration of patients who reported using cannabis within 30 days before their craniotomy with patients who did not report cannabis use were compared. The study was approved by the institutional review board. In addition, a certificate of confidentiality was obtained by the National Institutes of Health to further protect patients in the study. All study procedures described have been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Eligible patients were older than 18 years, had a Glasgow Coma Scale (GCS) score of at least 11 with a GCS verbal score of 5, had undergone a craniotomy as part of standard of care, had at least 1 analgesic medication prescribed for "as needed" (PRN), and were admitted to the NSICU. Patients were excluded if they were pregnant, if they were prisoners, if they were non–English speaking, if admission to the NSICU was expected to be less than 24 hours, or if the patient was in control of his/her own pain medication administration. Eligible patients were approached by a member of the research team after their surgery. Consented patients then completed a one-time self-report form the day after their craniotomy that discussed pain management, including cannabis use, before and after their craniotomy. Subjects were asked whether they had used cannabis within the last 30 days.[14] Electronic medical records (EMRs) were accessed to obtain demographics, information on patients' documented pain scores using a 0-to-10 numeric rating scale as well as the medication that was administered in the 24-hour postoperative period.

Participants were provided the self-report form in a manila envelope and asked to complete the survey at their leisure and put the survey back into the manila envelope. To provide additional anonymity, a study identification number was written on the survey and no other identifying information (eg, name or medical record) was on the survey.

As part of the standard of care, pain is evaluated at least once every 4 hours for all patients in the NSICU, as well as at the time a pain medication is administered and within 1 hour after the pain medication is administered. Standard-of-care pain is measured using a numeric 0-to-10 scale: 0 for no pain, 1 to 3 for mild pain, 4 to 7 for moderate pain, and 8 to 10 for severe pain. These pain scores correlate with the way our pain medicine administration orders are written. Patients reporting mild pain typically receive noncontrolled oral analgesics; those with moderate receive controlled substance medications orally, and those with severe pain receive controlled medications intravenously.

A 100-mm self-reported visual analog scale (VAS) was included on the self-report form to further examine overall pain experience. There were 2 VAS questions asked. The first was in regard to adequacy of pain control since their surgery (while the patient was in the NSICU), with the lower score indicating poor control and the higher score indicating excellent control. The second question was in regard to the amount of control, which ranged from not controlled to well controlled.

Descriptive statistics for demographic data were analyzed by looking at means (SD) and frequency (percentage). Student *t* test was run to compare cannabis and noncannabis users' overall reported pain levels. A Fisher exact test was then run to compare pain levels at different time points post craniotomy.

## Results

There were 46 patients who consented to participate. Of these, 1 was excluded from the analysis because he/she was found to have an endoscopic pituitary tumor resection and not a craniotomy. Of the 45 subjects used in analysis, the mean (SD) age of the patients was 57.16 (16.83) years, and 62.22% (n = 28) of the patients were female. Furthermore, 82.22% (n = 37) of the patients were White, 11.11% (n = 5) were African Americans, and 6.67% (n = 3) were others. Thirty patients reported no previous cannabis use, and 15 reported previous cannabis use in the last 30 days. The route for cannabis use included smoking (4), edible (4), and more than 1 method (7) including smoking, edible, and oils. As shown in Table 1, there were no statistically significant differences in the sex, age, race, or ethnicity of the 2 groups. The mean (SD) number of doses of pain medication received was similar comparing nonusers with users (10.13 [5.53] vs 11.27 [4.3], respectively; $P = .49$).

There was a difference in cannabis users versus nonusers comparing the mean (SD) respectively for pain severity reported on a 0-to-10 scale in the EMR for a 24-hour period (4.58 [3.24] vs 3.89 [3.37]; $P = .0056$). Reported pain levels within the first 24 hours postoperatively were generally higher in users compared with nonusers (Table 2). Fisher exact tests showed that there was a significant difference in pain reporting from 0- to 8-hour interval ($P < .0001$) and 9- to 16-hour interval ($P = .0128$) and the 17- to 24-hour interval ($P = .0426$) between users and nonusers (Table 2). No significant difference was found for age (59.5 [16.1] vs 52.5 [17.1]; $P = .1894$) nor for adequacy of pain control on the VAS (68.6 [18.2] vs 71.5 [21.8]; $P = .6584$). $\chi^2$ Test and Fisher exact test showed that none of the categorical variables (sex, race, ethnicity, and surgical procedure) is significantly associated with the user's categories (Table 1).

## Discussion

This is the first study examining cannabis users' pain control after a neurosurgical procedure, and despite the small sample size in this pilot study, the results

**TABLE 1. Demographic Information**

| | Users n = 15 | Nonusers n = 30 | *P* |
|---|---|---|---|
| Age, mean (SD), y | 52.5 (18) | 59.5 (16) | .1894 |
| Sex, n | | | .3845 |
| Male | 7 | 10 | |
| Female | 8 | 20 | |
| Race | | | .0523 |
| White | 11 | 26 | |
| African American | 4 | 1 | |
| Other | 0 | 3 | |
| Ethnicity | | | .5913 |
| Hispanic | 2 | 2 | |
| Non-Hispanic | 13 | 28 | |
| Type of craniotomy | | | .8831 |
| Tumor | 14 | 20 | |
| AVM | 0 | 1 | |
| Nerve | 0 | 1 | |
| Bleeding | 0 | 2 | |
| Aneurysm | 0 | 2 | |
| Not specified | 1 | 4 | |
| VAS Pain, mean (SD) | 62.8 (22) | 71.2 (23) | .2436 |
| Clinical Pain Scale | 4.6 (3) | 3.9 (3) | .0056 |
| Doses of medicines | 15 (11) | 30 (10) | .4914 |

Abbreviations: AVM, arteriovenous malformation; VAS, visual analog scale.

**TABLE 2.** Pain Level Reporting Over a 24-Hour Period After a Craniotomy

| Timing | Pain Rating | Users | Nonusers | *P* |
|---|---|---|---|---|
| 0–8 h postoperatively | None | 16.2% | 28% | <.0001 |
| | Mild (1–3) | 13.5% | 18.4% | |
| | Moderate (4–7) | 39.9% | 27.6% | |
| | Severe (8–10) | 30.4% | 26.0% | |
| 9–16 h postoperatively | None | 38.7% | 37.0% | .0128 |
| | Mild (1–3) | 17.7% | 11.4% | |
| | Moderate (4–7) | 22.6% | 37.1% | |
| | Severe (8–10) | 21.0% | 14.4% | |
| 17–24 h postoperatively | None | 18.6% | 36.3% | .0426 |
| | Mild (1–3) | 22.9% | 12.7% | |
| | Moderate (4–7) | 34.3% | 36.3% | |
| | Severe (8–10) | 24.3% | 14.5% | |

suggest that cannabis use has the potential to affect pain control or the perception of pain control. By examining subjects in an acute setting after neurological surgery, the findings extend previous authors who have examined cannabis in neuropathic pain control.[22,23] Although our findings differ from those of Stevens and Higgins[24] who find that postoperative analgesia is equally effective for cannabis and noncannabis users, none of the studies in that systematic review included neurosurgical patients.

It is unknown if cannabis users experience more pain at baseline, thus the reason for cannabis use at home, or experience more pain during hospitalization when the cannabis use is discontinued. Generally, the literature does not indicate that route of administration affects pain outcomes when comparing smoking with ingesting cannabis.[25] Users rated that they had worse pain (higher pain severity scores) documented in their EMRs. Although this difference is statistically significant, it may also be clinically significant because the patients may receive a different class of pain medication based on a pain scale of 3 out of 10 (mild pain) versus a pain scale of 4 out of 10 (moderate pain).

In this unit, the same medication regimen for postoperative craniotomies is used for almost all patients. This typically includes a lidocaine continuous infusion, scheduled oral (PO) methocarbamol muscle relaxer, noncontrolled PO medications such as acetaminophen PRN for mild pain, controlled PO medications such as acetaminophen + codeine or hydrocodone + acetaminophen PRN for moderate pain, and controlled intravenous medications such as fentanyl, hydromorphone, or morphine PRN for severe pain. This regimen works to control the pain for most patients, but if the pain is still uncontrolled, the nurse has to call the doctor to increase the dose or frequency of current medications or order additional pain medications. This pain regimen may not be the best option for people who use cannabis preoperatively.

Cannabis use should be better screened for preoperatively because of the prevalence of usage in this patient population. If we found an intervention that controlled pain more efficiently postoperatively for people who use cannabis, we could provide better pain control, which would result in a decrease in narcotic medications for the patients who are not truly benefiting from them. With the opioid epidemic raging in the United States, nonopioid treatments for patients are more favorable options.

## Limitations

Cannabis is a collective term for the plant that provides a combination of THC and CBD.[26] It is unlikely that any of our subjects used the same THC-CBD combination, which raises concern for internal validity.[27] In addition, this small study was conducted in a state where recreational and medicinal cannabis use is illegal, so there is no way to track the strains of the cannabis. It is also possible that subjects had different levels of use. We used self-report for both cannabis use and pain intensity; however, future studies may benefit from additional measures (eg, urine toxicity). A potential unmeasured confounder is that cannabis users may have a higher pain level preoperatively, or they may have unmeasured differences at baseline. Furthermore, a larger study would support additional variables being collected as potential confounders, such as the GCS. Given that cannabis is illegal in the state where this pilot study was conducted, cannabis use may have been underreported.[28]

## Nursing Implications

Nurses provide a crucial role in a patient's pain management. We assess and document a patient's pain, discern the best pain management intervention that is ordered for the situation, and administer the intervention. From this study, we have seen how cannabis use can affect reported pain levels of patients, which gives nurses more incentive to inquire about patient cannabis use. This research adds a foundation for future nursing research regarding pain management in patients who have used cannabis. Nurses are best positioned to conduct this research in an acute setting (eg, postcraniotomy) as we observe, administer, and assess the patients' pain, most often creating room for research on interventions that may lead to better pain control in acute patient care.

## Conclusion

In this pilot study, we found that one-third of the patients reported home use of cannabis in a state where cannabis is illegal. Of the participants who reported cannabis use in the past 30 days reported higher postoperative pain intensity than those who did not report cannabis use. Our study sample is small, and the study is observational and warrants the need for future research. For future studies, we would like to recruit patients from multiple sites to obtain a more generalizable result.

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