

# Anesthesia Toolbox

Sample PBLD Template

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## PedsF PBLD 11.3: Marijuana Use in Pediatric Patients: Implications for General Anesthesia

Instructor Version (14pt)

### Author: (12pt)

Leah Webb, MD, Pediatric Anesthesiologist, Assistant Professor  
Department of Anesthesiology, Children's Hospital Colorado, University of Colorado  
School of Medicine, Anschutz Medical Campus, Aurora, Colorado

### Disclosures:

None

### Learning Objectives: (12pt)

Upon completion of this activity, participants will be able to:

- Recognize the scope of marijuana use in the pediatric population
- Evaluate the surgical candidacy of an intoxicated patient
- Assess drug use in the adolescent in the presence or absence of his/her parents
- Develop an anesthetic plan for emergency surgery for an adolescent who has just used marijuana

### Case: (12pt)

At 0700 on Saturday morning, a 16-year-old, 65 kg male presents for ORIF of his left ankle. The prior evening, he tripped off a curb and sustained the injury. He is resting comfortably in the stretcher, appears sleepy, and smells of marijuana. He is not accompanied by his parents.

### 1) What is the prevalence of marijuana use in the adolescent population?

- *Marijuana use in the pediatric and adolescent population is significant and increasing. It necessitates additional considerations when marijuana users are encountered in the perioperative setting. Monitoring the Future (MTF) is an ongoing study of about 50,000 American adolescents and young adults that assesses their behaviors, attitudes, and values on a yearly basis. In 2017, MTF reported the following data for use of Marijuana/Hashish (Miech, 2017)*

Prevalence	8 <sup>th</sup> Grade	10 <sup>th</sup> Grade	12 <sup>th</sup> Grade
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<b>Lifetime (%)</b>	13.5	30.7	45
<b>Annual (%)</b>	10.1	25.5	37.1
<b>30-Day (%)</b>	5.5	15.7	22.9
<b>30-Day Daily Use (%)</b>	0.8	2.9	5.9

**2) What are some influences that affect adolescents' marijuana use?**

- *Legalization and decriminalization have led adolescents to view there is less harm from marijuana use and therefore recreational use and use for self-treatment of anxiety, insomnia, and other psychiatric conditions have increased.*
- *The incidence of accidental ingestions, mostly from edibles being mistaken for food, in the pediatric populations has increased alongside legalization and has resulted in an increased number of Emergency Room visits and calls to Poison Control Centers. (Campbell, 2017)*

**The patient reports that he is otherwise healthy with only a medical history of anxiety. No past surgical history. He has no allergies and takes no daily prescribed medications. He is in no distress, well developed and well-nourished with injected conjunctiva. His breathing is non-labored, with equal breath sounds bilaterally without wheezes, ronchi, or rales, and respiratory rate 18. Cardiac exam is notable for tachycardia with HR 110, but with regular rhythm and no murmurs, rubs, or gallops. Airway exam is unremarkable expect for the distinct odor of marijuana. When you ask about drug use, he looks away and becomes silent. After some gentle probing he admits to smoking marijuana on a daily basis.**

**3) What are signs and symptoms of acute marijuana intoxication? How long do the effects last?**

- *There are three main active ingredients responsible for the effects of marijuana: THC (tetrahydrocannabinol), the main psychoactive cannabinoid; CBD (cannabidiol), which is non-psychoactive; and anandamide (arachidonoyl ethanolamide), an endogenous ligand that affects the binding of THC and CBD to endocannabinoid receptors. Of the two most common "medical marijuana" species, Cannabis sativa has more psychotropic affects (including increased alertness, energetic sense), while Cannabis indica causes more relaxation and even lethargy. (Ammerman, 2015)*
- *While research has indicated some therapeutic benefits of cannabinoids (analgesia in chronic neuropathic pain, appetite stimulation, seizure control, and spasticity in MS) the biology is still not well understood. Adverse effects are not uncommon and can range from relatively benign physiologic changes to more serious psychiatric problems. Side effects include physical effects of increased heart rate and systolic blood pressure, conjunctival injection, dry mouth,*

*orthostatic hypotension, increased appetite, increased thirst, drowsiness, insomnia, and ataxia. In addition, marijuana use can result in anxiety symptoms, panic attacks, short-term memory loss, and hallucinations. Furthermore, ischemic stroke and acute coronary syndrome have been reported in youth. Ingestion by small children can result in a range of symptoms including drowsiness, ataxia, nystagmus, hypothermia, and hypotonia. Rare reports of respiratory depression and coma exist. Toxic ingestions have been seen in children, particularly in states with legalized recreational marijuana, and activated charcoal may be helpful if initiated within 2 hours of ingestion. (Ammerman, 2015)*

- *Cardiovascular effects of cannabis are numerous and mediated via several different pathways. Activation of the cannabinoid receptor 1 (CB1), transient receptor potential ankyrin type-1 (TRPA-1) channel, and vanilloid VR1 receptors have all been found to play a role in causing vasodilation, which in turn is thought to be responsible for reflex tachycardia. The increased heart rate can last for two to three hours. Chronic marijuana use attenuates these effects, which is thought to be due to increased parasympathetic mediation. (Goyal, 2017)*

#### **4) What are the effects of chronic MJ use?**

- *Neurodevelopmental changes in the adolescent brain are the main concern with marijuana use. While several factors are involved, the adolescent brain is at particular risk for developing substance abuse disorders. The younger the age of first use, the more likely the development of substance use disorder, including dependence or addiction. Emerging data studying brain structure and function suggests that marijuana use may alter the developing brain and neurocognitive functioning. Regular marijuana use has been shown to decrease performance on tests of working memory, visual scanning, cognitive flexibility, and learning. Lower overall cognitive functioning has been shown to correlate with the number of lifetime episodes of marijuana use reported by subjects. MRI has detected neural activity abnormalities that may correlate with changes in cognition and attention, including negative effects on spatial working memory, verbal encoding, and inhibition. The entire scope of effects is yet unknown, including whether there are “critical periods” with heightened vulnerability and whether changes can be reversed with reduction or cessation of use. These are just some of the ways in which the developing brain may be affected, but this remains an area of intense study. (Ammerman, 2015)*

#### **5) Are there additional NPO concerns due to the patient’s marijuana usage?**

- *While no official recommendations exist, appropriate NPO time and risk of aspiration may be altered in patients with recent marijuana use. Marijuana has*

*been shown to decrease gastric emptying of solid foods by as much as 30 to 120 minutes. (McCallum, 1999) As such, a typical 8-hour fast from solid food may be insufficient. Regardless of fasting time, it may be advisable to take aspiration precautions with chemoprophylaxis (with a non-particulate antacid, promotility agent, and H2-receptor blocker), rapid sequence induction, elevation of the head of bed (reverse Trendelenburg position) and use a cuffed endotracheal tube in these patients.*

**6) Assuming the patient meets state guidelines for the age of consent mandate by the state you are, can the patient consent himself for surgery if they have recently used marijuana?**

- *Regarding the patient's ability to consent himself for surgery, several factors must be addressed.*
  - *Determine if the patient meets criteria for substance intoxication: the DSM-V offers four diagnostic criteria for substance intoxication: recent ingestion; problematic behaviors or psychological changes developing during or shortly after substance use; evidence of substance-specific intoxication syndromes; and, symptoms not attributable to another medical condition or explained by another mental disorder, including intoxication with another substance.*
  - *(Donroe, 2017) [Regarding the intoxication syndrome, clinical signs can include euphoria, relaxation, increased appetite, paranoia, anxiety, and nausea, as well as physical effects (see above) including the distinct odor of marijuana inhalation.] (Donroe, 2017)*
  - *Assess for competency: this is a clinical decision. Competency is defined as the "patient's ability to reasonably understand the nature of his or her condition, the nature of any proposed treatment, and the consequences of refusing or agreeing to any proposed treatment." (Donroe, 2017) From a medico-legal standpoint, neither the presence of an intoxicating substance, nor any specific blood or lab test, alone is sufficient to deem a patient incompetent. (Donroe, 2017)*

**7) Can the parents be notified and what can be disclosed?**

- *A decision to involve the patient's parents, or relatives, can be guided by HIPPA (Health Insurance Portability and Accountability Act). Verbal consent by the patient is sufficient to allow a discussion with the parents. If the patient does not consent, a section [164.510(b) (3)] of the HIPPA privacy rule allows information disclosure to relatives when it is in the patient's best interest and specifically applies under circumstances where the patient is impaired by alcohol or drugs in*

*their decision-making capacity. Of note, it only applies to protected health information that directly pertains to the current condition. (Donroe, 2017) As always, if the nature of the injury or event is such that it requires emergent surgical/procedural intervention, some or all of these steps may need to be bypassed in the best interest of the preservation of "life and limb" for the patient.*

**8) What additional risks and complications should be disclosed to the patient (his parents)?**

- *Arguably there are special considerations and risks that should be discussed with the patient. As mentioned, there may be an increased risk of aspiration despite following the usual NPO guidelines. Changes in lung function and reactivity, discussed below, are an additional risk to consider. Pain control, see below, may be more complicated and difficult in the marijuana-using patient. Drug interactions, further discussed below, are a potential problem, especially given the varying effect on metabolism caused by marijuana and the paucity of data on many commonly used drugs when combined with marijuana exposure.*

**Other than left ankle x-ray, no other preoperative studies have been obtained.**

**9) What preoperative studies are indicated for this patient? Specifically, do you need PFTs to safely proceed and what, if any, abnormalities would you expect on this test?**

- *Currently, there are no recommendations or guidelines for preoperative studies to conduct in marijuana-using patients. However, some studies have examined the respiratory effects of marijuana and changes in PFTs. Marijuana smokers often experience respiratory symptoms including chronic cough, increased sputum production, dyspnea with/without exertion, hoarse voice, and chest tightness. Generally, studies have shown that there is not a decrease in FEV1/FVC ratio (as with tobacco smoking) with chronic marijuana use and, in fact, many chronic users may have an increased FVC alone, or with an increase in FEV1, as well. Acutely, THC has been shown to cause bronchodilatation, but chronic smokers tend to have increased airway resistance and reduced airway conductance. Yet, chronic marijuana smoking is not associated with COPD. It is thought this may be secondary to the anti-inflammatory properties and immunomodulatory effects of THC. Bullous lung disease and emphysema has been detected and high-resolution CT scan may show characteristic, peripheral cystic changes in chronic marijuana smokers. (Ribeiro, 2016)*

**10) What premedication is indicated?**

- *There are no guidelines for premedication in this patient population.*
- *As previously discussed, it may be advisable to administer aspiration prophylaxis. Depending on the patient exam, albuterol nebulization may be a helpful adjunct. In cases where marijuana intoxication is causing anxiety or panic attacks, benzodiazepines have been safely used. Arguably, preoperative hydration via intravenous volume administration may be helpful in dealing with tachycardia and orthostatic hypotension, if present.*

**The patient is brought to the OR and standard ASA monitors applied. His room air saturation is 93%. Via facemask, 100% FiO<sub>2</sub> is administered.**

**11) What are your concerns on induction of anesthesia in this patient?**

- *Induction concerns in this patient are not limited to, but should include, aspiration, bronchospasm, and laryngospasm. As discussed above, marijuana slows gastric motility. (McCallum, 1999) In addition, trauma in children has been shown to slow gastric motility. As such, an RSI and secured airway (with cuffed) ETT is likely advisable. Despite the bronchodilatation that can occur with marijuana, the lungs may still be “irritable” from smoke inhalation. One cannabis joint has been found to be equivalent to smoking ~2.5-5 cigarettes. While the effects of cigarette smoking are well known, the effects of marijuana smoking are less well known. However, marijuana tends to be smoked without a filter, with a shorter “butt” length, and at a higher temperature, all of which may affect lung function and reactivity. Use of alternative inhalation techniques—such as “water bong” and vaporizing—seems to reduce the amount of carcinogenic material inhaled and may have lesser effects on lung function. (Ribeiro, 2016)*

**12) What are the metabolic effects of marijuana and drug interactions to consider?**

- *Because marijuana has been found to affect cytochrome enzymes, there are drug metabolism concerns to consider. THC and CBD have long half-lives of about 30 hours for THC and 9-32 hours for CBD; and they are both highly lipophilic. CBD is highly protein bound. Its metabolism occurs through CYP450 enzymes (2C19, 3A4), which it also potently inhibits. Therefore, CYP inducers (phenytoin, carbamazepine) can decrease CBD concentrations. Because of CYP inhibition, CBD has been found to increase clobazam concentrations. This effect is particularly important when managing patients on antiepileptic agents metabolized by the CYP enzyme system. Other drug interactions are yet unknown. (Campbell, 2017)*

You decide to perform rapid sequence intubation and the patient is intubated with 7.0 cuffed ETT. Bilateral breath sounds are equal and clear; EtCO<sub>2</sub> is 40. Anesthesia is maintained with Sevoflurane in a 40% FiO<sub>2</sub> mixture with air. The patient's vital signs are stable throughout the case.

**13) What, if any, concerns do you have about extubation and how will you manage them?**

- *There are no clear guidelines for extubation in marijuana smokers. If the patient has particularly reactive airways, it may be advisable to proceed with deep extubation, assuming the patient has no contraindications. It may also be helpful to administer IV lidocaine 1 mg/kg prior to extubation to diminish airway reflexes, bucking, and coughing.*

**14) What are the implications of marijuana use on pain management?**

- *Pain management is complicated in cannabis users. While some studies exist, the data is still limited. One RCT (Karschner, et al) found that there was a dose-dependent response to pain and hyperalgesia with cannabis use. Those using a "medium" cannabis dose had pain reduction and those using a "high" cannabis dose actually had hyperalgesia to capsaicin injection.*
- *Cannabis has been used to for treating chronic pain, especially neuropathy, with success. Prescribing cannabis remains controversial and there are only a few FDA approved products on the market. Anecdotally, patients have reported a decreased need for opioid prescriptions after starting medical cannabis regimens. Studies have also shown decreased rates of opioid prescriptions and opioid-related mortality in states with medical cannabis laws. (Hill, 2017)*
- *Conflicting data exist on the effectiveness of cannabinoids for treating acute pain. Some studies have shown no difference in acute pain management when comparing cannabinoids to placebo; however, animal studies have shown cannabinoids to be useful in treating postoperative pain. Clinical evidence supporting the use of cannabinoids in acute and postoperative pain is lacking. (Echeverria-Villalobos, 2019)*

**15) Would a peripheral nerve catheter with continuous infusion be appropriate for postoperative analgesia for this patient?**

- *Given the above considerations, a multimodal pain management plan is appropriate for this patient. Of course, NSAIDs and acetaminophen are a mainstay of multimodal analgesia. The addition of a peripheral nerve block (PNB) seems reasonable and advisable. Cannabis use itself does not present a contraindication to PNB; and, given that hyperalgesia may be a side effect of cannabis use, nerve blockade may be*

*particularly helpful postoperatively. The decision of whether to place a catheter for continuous PNB should be based on the providers experience and clinical judgment. A substance-using patient may have trouble with follow up and care of a PNB catheter, which may be one reason to avoid placement. Otherwise, standard indications/contraindications should be considered when deciding to place a catheter.*

**Prior to extubation, single shot adductor canal and popliteal fossa nerve blocks are performed. Sevoflurane is discontinued and 1 mg/kg of IV lidocaine is administered. After demonstration of adequate strength, airway reflexes, and ability to follow commands, the patient is extubated. He receives a dose of acetaminophen and oxycodone in the PACU and is discharged home with no complaints of pain.**

**16) If the patient needed to be admitted, would you need to worry about withdrawal, and if so, what signs or symptoms might you observe?**

- *Cannabis withdrawal syndrome was only recently (in 2013) defined and incorporated into the DSM-V. Withdrawal is uncomfortable, but not particularly dangerous. Patients meet criteria if they have  $\geq 3$  of the following signs/symptoms: (Brezing, 2017)*
  - *irritability, anger, or aggression*
  - *nervousness or anxiety*
  - *sleep difficulty (such as insomnia or vivid dreaming)*
  - *decreased appetite or weight loss*
  - *restlessness*
  - *depressed mood*
  - *$\geq 1$  of the following uncomfortable physical symptoms: abdominal pain, shakiness/tremors, sweating, fever, chills, or headache*
- *Treatment for cannabis withdrawal and cannabis use disorder (which affects 8-12% of chronic users) is mostly supportive and relies heavily on psychotherapy. Numerous pharmacological agents have been or are under investigation (including noradrenergic, serotonergic, and gamma-aminobutyric acid agents, cannabinoid receptor 1 agonists, cannabidiol or CBD, cannabinoid receptor 1 antagonists, naltrexone, n-acetylcysteine, lithium, quetiapine, and oxytocin) with varying degrees of success. (Brezing, 2017)*
- *Cannabis withdrawal syndrome can occur as early as 24 hours after last use but usually peaks by one week. The symptoms can continue for up to 1 month. (Brezing, 2017)*

### **References and Suggested Reading: (12pt)**

- 1) Ammerman S, Ryan S, Adelman WP. The Impact of Marijuana Policies on Youth: Clinical, Research, and Legal Update. *Pediatrics*. 2015;135(3). doi:10.1542/peds.2014-4147

- 2) Brezing CA, Levin FR. The Current State of Pharmacological Treatments for Cannabis Use Disorder and Withdrawal. *Neuropsychopharmacology*. 2017;43(1): 173-194. doi:10.1038/npp.2017.212
- 3) Campbell CT, Phillips MC, Manasco K. Cannabinoids in Pediatrics. *The Journal of Pediatric Pharmacology and Therapeutics*. 2017;22(3):176-185. doi:10.5863/1551-6776-22.3.176
- 4) Donroe JH, Tetrault JM. Recognizing and Caring for the Intoxicated Patient in an Outpatient Clinic. *Medical Clinics of North America*. 2017;101(3):573-586. doi:10.1016/j.mcna.2016.12.012
- 5) Echeverria-Villalobos M, Todeschini AB, Stoicea N, Fiorda-Diaz J, Weaver T, Bergese SD. Perioperative care of cannabis users: A comprehensive review of pharmacological and anesthetic considerations. *Journal of Clinical Anesthesia*. 2019;57:41-49. doi:10.1016/j.jclinane.2019.03.011.
- 6) Goyal H, Awad HH, Ghali JK. Role of cannabis in cardiovascular disorders. *Journal of Thoracic Disease*. 2019;9(7):2079-2092. doi:10.21037/jtd.2017.06.104
- 7) Hill KP, Palastro MD, Johnson B, Ditre JW. Cannabis and Pain: A Clinical Review. *Cannabis and Cannabinoid Research*. 2017;2(1):96-104. doi:10.1089/can.2017.0017
- 8) McCallum, Soykan, Sridhar, Ricci, Lange, Plankey. Delta-9-tetrahydrocannabinol delays the gastric emptying of solid food in humans: A double-blind, randomized study. *Alimentary Pharmacology and Therapeutics*. 1999;13(1):77-80. doi:10.1046/j.1365-2036.1999.00441.x
- 9) Miech RA., Schulenberg JW, Johnston LD, Bachman JG, O'Malley PM, Patrick ME. (December 14, 2017). "National Adolescent Drug Trends in 2017: Findings Released." *Monitoring the Future: Ann Arbor, MI*. Retrieved from <http://www.monitoringthefuture.org>
- 10) Ribeiro LI, Ind PW. Effect of cannabis smoking on lung function and respiratory symptoms: A structured literature review. *Npj Primary Care Respiratory Medicine*. 2016; 26(1):17-20. doi:10.1038/npjpcrm.2016.71