



## Case report

## Lung injury from inhaling butane hash oil mimics pneumonia

Ryan P. Anderson\*, Katie Zechar



## A B S T R A C T

**Introduction:** “Dabbing”, a relatively new form of THC use which utilizes Butane

Hash Oil (BHO), an extraction of dried cannabis containing high levels of butane and terpene byproducts. The extraction process yields a waxy substance that is heated, vaporized and inhaled. We describe a lung injury as a result of BHO use.

**Case:** A previously healthy 18-year-old female presented to the ED with shortness of breath for 3–4 days. Initial oxygen saturation was 79% on room air. She was refractory to bronchodilators, steroids and supplemental O<sub>2</sub>. She has a 1-pack year smoking history and daily BHO abuse. Chest x-ray was positive for bilateral patchy infiltrates with mild hyperinflation. CT was negative for Pulmonary Embolus or other acute pathologic process. Sputum gram stain and blood cultures were negative. Arterial blood gases confirmed a pO<sub>2</sub> of 73 mmHg. On physical exam she was tachycardic and tachypneic. Respiratory auscultation showed decreased air entry bilaterally with diffuse expiratory wheezing, bilateral rhonchi and a prolonged expiratory phase. We concluded her severe pneumonitis was secondary to daily BHO inhalation.

**Discussion:** Heating BHO to high temperatures, releases up to 75% of THC, compared to 5–20% THC in traditional smoked cannabis. At 978°F terpenes degrade into methacrolein and benzene. Methacrolein is structurally similar to acrolein, a pulmonary irritant, which causes acute lung injury and pulmonary edema in laboratory animals. We hypothesize a mechanism of lung injury and acute respiratory failure secondary to inhalation of high levels of methacrolein and benzene related to relatively novel phenomena of BHO use.

## 1. Introduction

“Dabbing” is a relatively new form of inhaling high concentrations of Tetrahydrocannabinol (THC) utilizing Butane Hash Oil (BHO). BHO is produced using liquid butane to extract high levels of THC from dried cannabis; the resulting product contains both butane and terpene byproducts. The extraction process yields a waxy substance that is then heated, vaporized and subsequently inhaled. We describe a case involving inhalation of BHO that lead to an acute lung injury in a patient presenting with symptoms of atypical pneumonia.

## 2. Case summary

A previously healthy 18-year-old female presented to the Emergency Department with complaints of shortness of breath for 3–4 days. She was found to have acute hypoxic respiratory failure with oxygen saturations of 89% at rest and 79% during ambulation, while on room air. She was initially given three breathing treatments, IV steroids and oxygen with an FiO<sub>2</sub> of 36% via nasal cannula, however, remained hypoxic saturating at 90%. She further complained of a productive cough, nausea and headache. She denied chest pain or fever. On physical exam she was noted to be tachycardic and tachypneic. Respiratory auscultation demonstrated decreased air entry with diffuse expiratory wheezing, bilateral rhonchi and a prolonged expiratory phase with obvious use of accessory respiratory muscles. She has a 1-pack year

smoking history and stated she had smoked marijuana infrequently in the past.

She was admitted to a different hospital one month prior for similar symptoms. She was treated with breathing treatments, antibiotics, IV steroids and Tamiflu; although influenza titers were negative.

Work up included a PA chest x-ray (see Fig. 1) indicating mild hyperinflation without any acute pathologic process. Due to the severity of her respiratory distress a CT angiogram with PE protocol was completed; no evidence of a PE was found, however the scan demonstrated bilateral patchy infiltrates (see Figs. 2 and 3). Initial labs revealed leukocytosis with a WBC count of 23.8 thou/mcL with a neutrophil predominance of 18.7 thou/mcL and eosinophilia of 1.6 thou/mcL. Sputum gram stain and culture were negative. Arterial blood gases showed a pH of 7.43, pCO<sub>2</sub> of 29.1 mmHg, pO<sub>2</sub> of 73 mmHg and an HCO<sub>3</sub><sup>-</sup> of 19.3 mMol/L. Ongoing severe hypoxia prompted further work up of allergic bronchopulmonary aspergillosis (ABPA), alpha-1 antitrypsin deficiency, HIV and influenza; however, all tests were negative. A bronchoalveolar lavage (BAL) was not part of the workup, however if the patient showed signs of lipid pneumonia (subacute onset with hemoptysis, chest pain, and fever or with markedly dense nodules on CT) a BAL would be useful to exclude this diagnosis, characterized by lipid-laden macrophages.

Several days into the hospital stay, the patient elaborated further on her marijuana usage and stated she frequently inhaled vaporized marijuana in the form of Butane Hash Oil. She would inhale amounts

\* Corresponding author.

E-mail address: [ryan.anderson@students.rossu.edu](mailto:ryan.anderson@students.rossu.edu) (R.P. Anderson).

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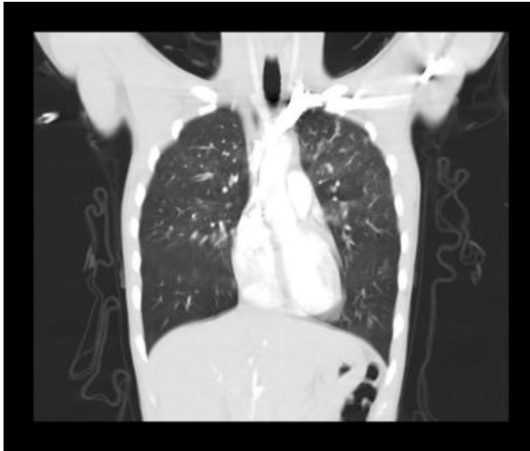


Fig. 1. Computed Tomography Scan (CT) indicating patchy bilateral infiltrates.



Fig. 2. Posteroanterior (PA) Chest x-ray indicating mild hyperinflation.



Fig. 3. Computed Tomography Scan (CT) indicating patchy bilateral infiltrates.

approximate to 1g, 1–2 times per day and had been doing so for the past 3 years. She stated she inhaled BHO 1 week, or less, prior to each of her two hospital admissions.

### 3. Diagnosis

Severe pneumonitis with acute hypoxic respiratory failure secondary to Butane Hash Oil inhalation.

### 4. Discussion

Dab, or dabbing, is the colloquial street term used by individuals that inhale butane hash oil, named in part to the small amount of BHO used each time. Our patient described the meticulous and very dangerous process of producing BHO. It begins with “blasting” or spraying liquid butane through a glass tube containing dry cannabis. A filter is used at one end of the glass tube which entraps the large pieces of cannabis. This allows the liquid remnants of THC, one of the psychoactive ingredients in cannabis, and butane to pass into a bowl. The bowl is then placed on a hot surface to allow for the partial evaporation of the butane leaving behind a sticky brown substance, similar in texture to wax, which is then known as BHO. When made illegally there are no guidelines that dictate an acceptable level of butane remaining in the product. Individuals using an unregulated street product can be inhaling up to 75% THC, compared to 5–20% THC in traditional smoked cannabis [1,2], and an unknown level of pure butane and terpene ranging from 0.1 to 34% [3]. When sold legally at a dispensary in a state where cannabis is legalized, such as Oregon, the guidelines state the level of butane must be less than 5000 ppm [4].

Our patient described her process of inhaling BHO with the use of a “Maverick” glass water pipe, 4-5-inch-long titanium cylindrical piece known as a “nail”, a propane blow torch and a small metal wire to hold the dab. The nail would be heated with the propane blow torch until it became bright red in color; temperatures ranging from 900 to 1075°F [3]. A dab of BHO on the end of the metal wire would then be touched against the nail causing an instant vaporization. The heated vapor would then be inhaled through the top of the pipe.

At approximately 978°F high levels of terpene, which are aromatic oils found in cannabis [3], degrade into various byproducts; of most importance are the noxious irritants Methacrolein and Benzene [4]; both known carcinogens. Methacrolein has been shown to be structurally similar to Acrolein, a powerful pulmonary irritant and carcinogen [3]. Studies have shown that high levels of Acrolein can lead to acute lung injury and pulmonary edema in laboratory animals [3].

We propose our patient developed an acute lung injury after she heated the nail to a temperature most likely exceeding 900°F; as she stated she would heat the nail until it was bright red. At this temperature, there was likely an increased release of the pulmonary irritants Methacrolein and Benzene, as well as hot vapor [3]. The patient also stated the BHO was not purchased legally, indicating that the level of butane in the product was unknown. There is a likely probability that a high level of inhaled butane also contributed to her symptoms.

The only literature on this subject matter we could find involved a 19-year-old male in 2016 whom was diagnosed with severe pneumonitis after inhalation of butane hash oil [5]. Commonalities in these two cases are summarized in Table 1, previous case clinically more severe, both clinical courses were similar with response to respiratory support and steroids.

Our case helps bring to light the lack of research involving the use of BHO and its acute and unknown long-term health effects. Our patient informed us that some individuals using BHO believe it is safer to use than smoking cannabis in a cigarette form. Since they are not inhaling burned cannabis they believe there will be “less damage” to their lungs because they’re inhaling vapor instead of smoke.

**Table 1**  
Comparison of the two documented cases of lung injury secondary to BHO inhalation.

Previous case (19 y/o Male)	Current case (18 y/o Female)
Young patient without comorbid medical history, positive rare tobacco use Daily THC use and temporal relation to BHO (6 days prior to ED presentation) Eosinophilia on BAL Primarily hypoxic resp. failure requiring intubation/ventilation and home O2 at d/c	Young patient without comorbid medical history, current smoker with 1 pack year hx Daily BHO use and temporal relation to BHO (1 week prior to ED presentation) Eosinophilia on CBC Primarily hypoxic resp. failure requiring high flow O2 in hospital, no home O2 requirement
Clinical improvement with steroids Chest pain and trace hemoptysis present	Clinical improvement with steroids Chest pain and hemoptysis absent

## 5. Conclusion

Butane Hash Oil is an emerging popular trend because of its high percentage of THC consumed in just one inhalation. The lack of literature and research on this topic makes the short and long-term effects on individual health largely unknown. While our patient improved in the hospital with medical treatment, it is unknown if she will suffer any long-term permanent effects of inhaling hash oil containing butane and various byproducts of terpene.

Lung injury, as a result of BHO inhalation, should be considered when a patient with a history of marijuana related drug use presents with symptoms similar to pneumonia.

## Conflicts of interest statement

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this case report.

**Author names:** Ryan P. Anderson, MS3; Katie Zechar, MD.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.rmcr.2019.01.002>.

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