# *n*-Butane Canister Foreign Body

This case of a man with a rectal foreign body—which contains butane—demonstrates the toxicity and safety considerations confronted routinely by emergency physicians.

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## CASE

A 42-year-old man presents to the ED after he is unable to remove an intentionally placed rectal foreign body. The patient reports the foreign body is a cylindrical butane gas canister that is normally intended for the purpose of refilling a torch. The patient complains of mild rectal discomfort and being able to taste and smell the gas. He denies "huffing" the gas, euphoria, or change in mental status.

A hydrocarbon-like odor emanates from the patient, prompting his placement in an isolated area of the ED for safety. On initial physical examination, he is alert and oriented. Vital signs include a blood pressure of 111/71 mm Hg; heart rate, 78 beats/min; respiratory rate, 18 breaths/min; and temperature, 36.1°C. Findings from his neurologic, cardiac, and pulmonary examinations are normal. His abdomen is nontender and nondistended, with active bowel sounds. On deep digital rectal exam, a solid foreign body is palpable. Stool is without blood, and no anal injury is noted.

Laboratory results, including basic metabolic panel, complete blood count, and urinalysis, are normal. An ECG demonstrates sinus rhythm with normal QRS and QTc intervals. A supine radiograph of the abdomen demonstrates a nonobstructive bowel gas pattern, with air and stool seen throughout the colon. A 12.3 × 4.3–cm cylindrical radiopaque foreign body overlies the region of the rectosigmoid colon (Figure 1). On the chest radiograph, no free air or other abnormality is noted.

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## BUTANE

### Description and Uses

*Butane* is a volatile hydrocarbon (boiling point, -0.5°C) containing four carbon atoms. Typically, the term refers to the unbranched *n*-butane isomer (Figure 2, page 21). *Methylpropane* refers to *i*-butane or isobutane (Figure 3, page 21). The canister is filled with compressed *n*-butane gas, which is colorless and has a pleasant hydrocarbon odor, though stenching agents may be added. Butane is highly volatile, with rapid evaporation from its compressed liquid state (liquid petroleum gas). Butane may be found in torches and cigarette lighters. It is also used as a propellant in spray deodorants and room fresheners and as a refrigerant.

Butane is used as a recreational inhalant. It is usually inhaled after it has been sprayed into a cloth ("huffing"). Butane has a low blood-gas partition coefficient, 0.019, leading to rapid passage through the blood-brain barrier to produce euphoria and sedation. The specific mechanism by which butane and other hydrocarbons produce euphoria is unknown but is probably due in large part to nonselective neuronal membrane effects. Unlike halogenated hydrocarbons, butane enhances agonist action on the $GABA_A$ (γ-aminobutyric acid A) receptor only at concentrations that exceed those required to produce anesthesia.[1] Thus, other receptors or mechanisms are likely involved at concentrations achieved with recreational use.

## TOXIC EFFECTS

Simple asphyxia may result if *n*-butane gas displaces a sufficient amount of oxygen in inspired air, effectively reducing $F_{IO_2}$ levels. This has been reported to occur in persons who abuse butane,[2] including those who


**FIGURE 1. Rectal foreign body (butane canister).**

do so for autoerotic purposes.[3] Rapidly progressive bilateral pulmonary infiltrates occurred in a 19-year-old man following a "fire-breathing" trick in which he filled his oral cavity with butane gas from a cigarette lighter, then exhaled the volatile vapors over an open flame to produce a flame-throwing effect.[4] Although butane is heavier than air and may have descended the bronchial tree, causing chemical pneumonitis, heat injury may have been responsible for this outcome.

Barotrauma, including pneumothorax, pneumomediastinum, and subcutaneous emphysema, may result from huffing butane gas[5]; however, the trauma is related to the deep inhalation and the Valsalva maneuver, not to a toxic property of the butane gas.

Persons exposed to butane may sustain cold thermal injury, since temperatures as low as -40°C can be achieved when compressed gases expand as they are sprayed out of their canister. For this reason, cans containing butane often carry a safety warning to hold the can at a minimum distance of 6 inches and not to spray for a prolonged period of time. The cold injury sustained to oropharyngeal mucosa from huffing (or, in this case, to intestinal mucosa from rectal insertion) butane gas can be severe and may require surgical management.[6] Due to the presence of the leaked butane gas and possible compromised intestinal mucosa from cold thermal injury, the patient is at risk for perforation and subsequent butane gas emboli. Although the use of hyperbaric oxygen therapy for butane gas emboli has not yet been described in the literature, it seems to be a reasonable option if time and circumstances permit.

The most frequent life-threatening toxicity from butane gas exposure is myocardial sensitization leading to dysrhythmia and death. *Sudden sniffing death* is the term used to describe the consequences of myocardial sensitization to catecholamines from huffing solvents. In most cases, the inhalant gas alters the delayed rectifier potassium channel and prolongs repolarization, simultaneously raising the likelihood that an ectopic beat will occur and predisposing the myocardial tissue toward conduction of reentrant dysrhythmias.[7] Although this is more commonly associated with the halogenated hydrocarbons, there are numerous reports of ventricular fibrillation and death following butane huffing.[8,9] Hypoxia may be involved as well. The dysrhythmia is often preceded by an event that would predictably cause sudden catecholamine release.

One case report tells of the sudden collapse of a 15-year-old girl huffing butane who was discovered by police.[9] In another case study, a man huffed butane, ran out of his room, collapsed, and died.[2]

In addition, there is a single case study proposing that coronary vasospasm can result from butane huffing.[10] After sniffing seven canisters of butane, a 14-year-old boy experienced severe anterior chest pain lasting 15 minutes. Subsequently, he collapsed and was found to have extensive anterior myocardial infarction complicated by ventricular fibrillation. Cardiac catheterization revealed patent coronary arteries with severe anterolateral and apical left ventricular wall hypokinesia. It was assumed that intense coronary artery spasm had occurred.

## CASE CONTINUED

Attempts by ED and surgical staff to manually remove the foreign body with procedural sedation are unsuccessful. Deep sedation and analgesia to be given in the operating room are offered to the patient, with the explanation that if transanal removal is unsuccessful, general anesthesia and laparotomy will be required. The patient refuses consent.

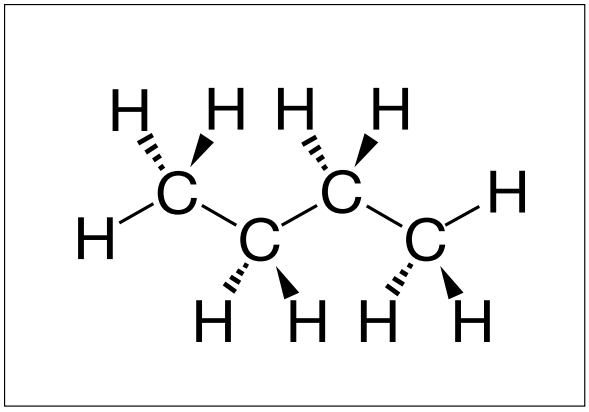

**FIGURE 2. The unbranched chemical structure of *n*-butane $C_4H_{10}$, butane.**

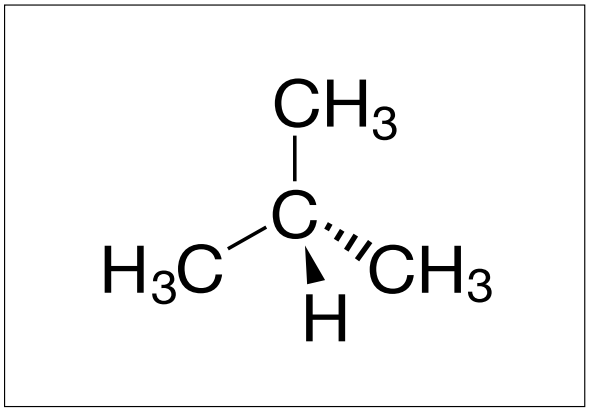

**FIGURE 3. The branched chemical structure of *i*-butane $C_4H_{10}$, methylpropane.**

What is the appropriate disposition for this patient who is attempting to elope from the ED with an internalized leaking *n*-butane gas canister? ED and surgical staff are concerned for the safety of the hospital staff and the patient, given the presence of a leaking flammable gas. To determine whether the patient is experiencing central nervous system effects from the volatile hydrocarbon, a psychiatric consultation is obtained. It is found that the patient's thought processes are illogical and that he has paranoid ideations regarding the surgeon's intentions; therefore, it is deemed that he lacks decisional capacity.

### Sedative Options

The patient, upon being told that he will be involuntarily admitted, could experience a catecholamine release that could lead to a life-threatening cardiac dysrhythmia. In this and other cases, selection of agents for sedation should be made carefully. Theoretically, agents with the potential to inhibit potassium channels, such as the antipsychotics, should be avoided.[7] Benzodiazepines or other GABA-ergic agents (eg, propofol) are preferred. β-Adrenergic antagonists may prevent or treat catecholamine-driven dysrhythmias. Propranolol and esmolol have both been used successfully to manage ventricular dysrhythmias following inhalant abuse.[11,12]

If removal of the potentially leaking butane canister necessitates conversion to general anesthesia and laparotomy, precautions will be required. Use of halogenated inhalational anesthetics should be deferred to avoid further myocardial sensitization. In addition, use of a cautery is contraindicated due to the flammability of butane.

## CONCLUSION

In the operating room, deep sedation is sufficient to allow manual removal of the canister. The rectal mucosa appears intact. No further complications are noted, and the following day, the patient tolerates food and is discharged. □

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