

Case Report and Literature Review of Oropharyngeal Frostbite Injury From Recreational Use of Nitrous Oxide

Robert E. Gurevich MD,¹ Ajibola B. Bakare MD, PhD,^{2,3} Jonas Nielsen,² Katie L. Melder MD⁴

¹Department of Otolaryngology, Tulane University School of Medicine, New Orleans, LA. ²Tulane University School of Medicine, New Orleans, LA. ³Department of Surgery, University of Arkansas for Medical Sciences, Little Rock, AR. ⁴Department of Otolaryngology – Head and Neck Surgery, Louisiana State University, New Orleans, LA.

Abstract

Background: Recreational use of inhaled nitrous oxide (N₂O) is rising due to its accessibility and ease of use. Although rare, it can cause aerodigestive thermal injuries. We report a case of a 24 year-old male with severe oropharyngeal frostbite after N₂O inhalation, presenting with palatal ulcerations and uvular necrosis. He required ICU care, IV steroids, and antibiotics. A literature review identified similar cases of N₂O-related aerodigestive frostbite.

Methods: A literature review was conducted across Pubmed, Embase, and Web of Science using the keywords “whippets”, “nitrous oxide”, and “frostbite” focusing on English language articles reporting upper airway injury due to volatile substances from 1980 to February 24, 2025. We included full length articles, case series, and short reports given the rarity of these injuries in the literature.

Results: N₂O was the most common frequently reported inhalational frostbite exposure, with outcomes ranging from same-day discharge to emergency tracheostomy. Systemic steroids and empiric antibiotics were commonly administered across all cases.

Conclusions: Aerodigestive frostbite injury is a rare but potentially life-threatening outcome of N₂O abuse. Symptoms can quickly progress from edema and pain to airway obstruction. There should be a low threshold for intervention to protect the airway.

Objective

This case report and literature review highlights the importance of early intervention to prevent aerodigestive frostbite complications from recreational N₂O use.

Results

- Identified 11 cases of aerodigestive frostbite, with a median age of 27.5 year. Most patients were male.
- 8 cases involved pressurized N₂O, including 4 cases from recreational inhalation directly from whipped cream chargers (“whippets”). One case involved inhalation from a balloon. Other exposures included dry ice, liquid nitrogen, automotive and medical N₂O canisters, and pressurized hydrofluorocarbons.
- All cases involved tissue frostbite, with severity and location varying by exposure source and route.
- Outcomes ranged from same-day discharge to ICU care and emergency tracheotomy.
- Most cases were treated with systemic steroids and empiric antibiotics.

Results

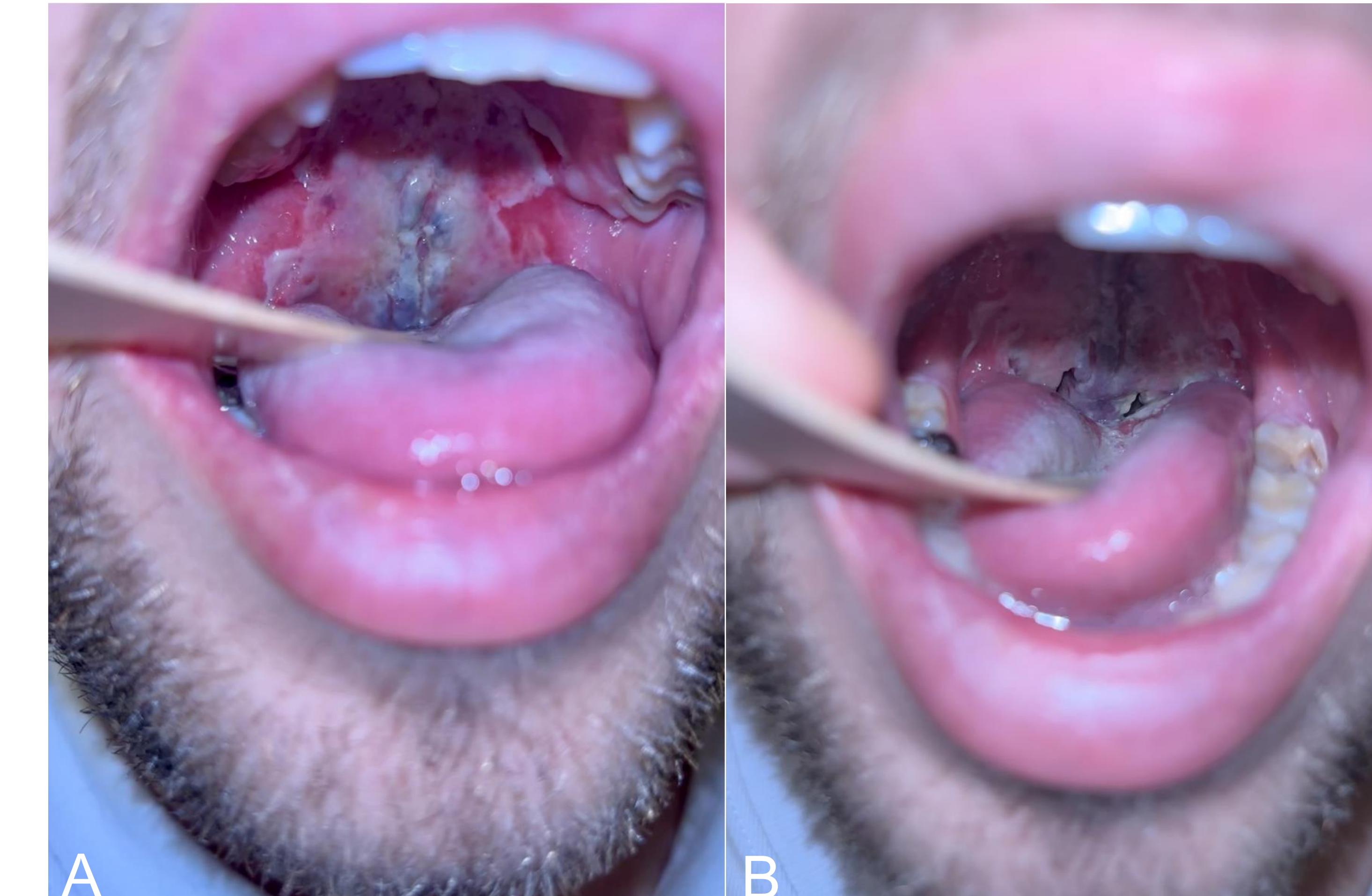


FIGURE 1: Clinical appearance 48 hours following injury. A) Pseudomembranes of the hard and soft palate. B) Uvular edema and early signs of necrosis

Case Report

A previously healthy 24-year-old male presented to the emergency room of a level 1 trauma center 48 hours after inhalation of N₂O in a social setting. The patient was at a party when a friend discharged a 1 liter cylinder marketed as a ‘whipped cream charger’ directly into his oral cavity in an uncontrolled manner. He immediately noted odynophagia and dysphagia. He presented to a rural ED after 24 hours complaining of progressive dysphonia and shortness of breath. He reported symptomatic improvement after 8 mg of IV dexamethasone. Patient was transferred to a tertiary medical center for ENT evaluation. Examination revealed mucosal ulceration of the palate, sloughing mucosa in the nasopharynx and early necrotic changes of the uvula (**Figure 1**). There was edema and pooling secretions in the postcricoid region but no overt laryngeal involvement on flexible laryngoscopy. Due to concern for worsening airway swelling or dislodging necrotic debris causing airway obstruction, the patient was admitted to the ICU for monitoring. He was treated with a limited steroid taper and IV clindamycin. After 24 hours, he showed continued symptomatic improvement and was stable for discharge. Complete resolution of symptoms was noted at one week follow up with physical exam unremarkable except for oropharyngeal erythema.

Literature Review

Citation	Age-Sex	Exposure	Site of injury	Interventions	LOS (days)	Outcome
Bagerman 2020	16 - M	N ₂ O inhaled, balloon	Larynx	Endotracheal intubation for 2 days, Dexamethasone, and nebulized adrenaline	3	No permanent injury noted at discharge, no follow up noted
Chan 2018	24 - M	N ₂ O inhaled, industrial automotive canister	Oral cavity, oropharynx, larynx	Endotracheal intubation for 1 day, dexamethasone, topical sucralfate	NR	Near complete healing at 2 week follow up, no further follow up noted
Svartling 1996	40 - M	N ₂ O, biomedical canister	Oral cavity, pharynx, larynx	Awake tracheotomy, methylprednisolone, cefuroxin, metronidazole, serial debridement	21	5 month follow up with scarring of the lips, tongue, and oral mucosa
Rowson 2023	30 - M	N ₂ O, whipped cream charger	Oral cavity, pharynx	Dexamethasone, amoxicillin	2	Near complete resolution at discharge, no further follow up noted
Ohki 2012	26 - M	Dry ice	Oral cavity	Hydrocortisone, flomoxef	5	Complete resolution at 3 weeks
Divya 2018	30 - F	Liquid nitrogen	Oral cavity	Topical Triamcinolone	0	Complete resolution at one week follow up
Albright 1999	15 - M	Pressurized FHC	Oral cavity, pharynx, larynx	Nasal intubation for 2 days, IV steroids and antibiotics	2	Complete resolution at follow up
Baran 2021	20s - M	N ₂ O tank	Oral cavity	Oral Hygiene, antibiotics	NR	NR
Chen 2023	29 - U	NR	Oral cavity	Local dressings	NR	NR
Murphy 2024	17 - F	N ₂ O tank	Oral cavity	Silver dressings, paraffin	NR	Complete resolution at 10 days
McCall 2025	30 - F	N ₂ O canister	Oropharynx, Larynx	IV Dexamethasone	NR	Improvement 48 hours after discharge

TABLE 1: Characteristics of included studies. (N₂O –Nitrous oxide; FHC- flurohydrocarbons; M-Male; F-Female; U-Unknown; LOS- Length of Stay, NR-Not Reported)

Conclusion

Recreational inhalation of N₂O has increased in recent decades. Although aerodigestive frostbite injuries are rare, clinicians should be prepared to recognize and manage them. Life threatening airway obstruction can develop hours to days after the initial injury, making ongoing vigilance essential. Systemic steroids and empiric antibiotics may aid treatment, and clinicians should maintain a low threshold for airway intervention due to the potential for rapid deterioration.

References

- Recreational nitrous oxide use in Europe: situation, risks, responses | www.euda.europa.eu. Europa.eu. Published 2024. https://www.euda.europa.eu/publications/topic_overviews/recreational-nitrous-oxide-use-europe-situation-risks-responses_en
- van Amsterdam J, Nabben T, van den Brink W. Recreational nitrous oxide use: Prevalence and risks. *Regul Toxicol Pharmacol*. 2015;73(3):790-796. doi:10.1016/j.yrtph.2015.10.017
- Backe A, Almås C, Colyer-Patel K, Cousin J. Does nitrous oxide addiction exist? An evaluation of the evidence for the presence and prevalence of substance use disorder symptoms in recreational nitrous oxide users. *Addict Behav*. 2019;87:112-116. doi:10.1016/j.addbeh.2019.112-116
- Arterial swelling due to inhalation frostbite injury after the recreational use of nitrous oxide – De Intensivist. De-intensivist.nl. Published 2020. Accessed February 17, 2025. <https://de-intensivist.nl/arterial-swelling-due-to-inhalation-frostbite-injury-after-the-recreational-use-of-nitrous-oxide/>
- Chan SA, Almeida C, Comer J. Upper aerodigestive tract frostbite from inhalation of automotive nitrous oxide. *Eur Nose Throat J*. 2018;97(9):E13-E14. doi:10.1177/1455613018700903
- Sugunan S, Rama S, Tan T, Taitanen O. Life-threatening airway obstruction from nitrous oxide induced frostbite of the oral cavity. *Anesth Intensive Care*. 1995;24(6):717-720. doi:10.1177/0310579X95024006017
- Rowson AC, Yiu MX, Tan HB, Prasad J. Recreational nitrous oxide-induced injury to the soft palate. *Clin Case Rep*. 2023;11(9):e1785. Published 2023 Aug 28. doi:10.1002/ccr3.7288
- Ohki M, Ishikawa J, Kikuchi S. Oral frostbite due to dry ice. *Ann Otol Rhinol Laryngol*. 2012;121(10):675-677. doi:10.1177/000348941212101009
- Divya VC, Saravananthikyan A. Infrared frostbite and Leidenfrost effect. *Aust Dent J*. Published online April 21, 2018. doi:10.1111/ad.12815
- Almås C, Colyer-Patel K, Cousin J. Recreational nitrous oxide use in Europe: situation, risks, responses | www.euda.europa.eu. Europa.eu. Published 2024. https://www.euda.europa.eu/publications/topic_overviews/recreational-nitrous-oxide-use-europe-situation-risks-responses_en
- Baran KC, de Vries M. Frostbite of the mouth after partying. *BMJ*. Published online June 23, 2021;n1441. doi:10.1136/bmjjn1441
- Chen JHC, Eriksson S, Mohamed H, Bhatti S, Frew Q, Barnes O. Experiences of frostbite injury from recreational use of nitrous oxide canisters in a UK burns center: Not a laughing matter. *Journal of Plastic, Reconstructive & Aesthetic Surgery*. 2023;63:282-288. doi:10.1016/j.bjps.2023.05.012
- Murphy D, Leon R, Carr S, de Blasac M. Frostbite injuries from recreational nitrous oxide use. *Pub Med*. 2024;117(2):910-910