

Cryogenic burns to the upper aerodigestive tract following recreational nitrous oxide inhalation

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Nitrous oxide (N_2O) is a tasteless, colourless gas used commonly as a short-acting inhalational anaesthetic. It is also publicly available for use in food preparation. N_2O is inhaled recreationally, most often from pressurised canisters for cream whippers (commonly referred to as “nangs”), giving brief euphoria or dissociation.^{1,2} The gas rapidly depressurises when it is expelled from the canister, causing its temperature to drop to as low as -55 degrees Celsius in accordance with Boyle’s law.^{3,4} Balloons are often filled with N_2O for inhalation, though some users inhale directly from the canister.¹ Recreational N_2O use is becoming increasingly common.^{1,2} While short-term adverse effects, including transient cognitive impairment and hypoxia are uncommon, inhalation of rapidly depressurising N_2O can cause cryogenic airway burns with resulting oedema and airway compromise.^{1,5-8}

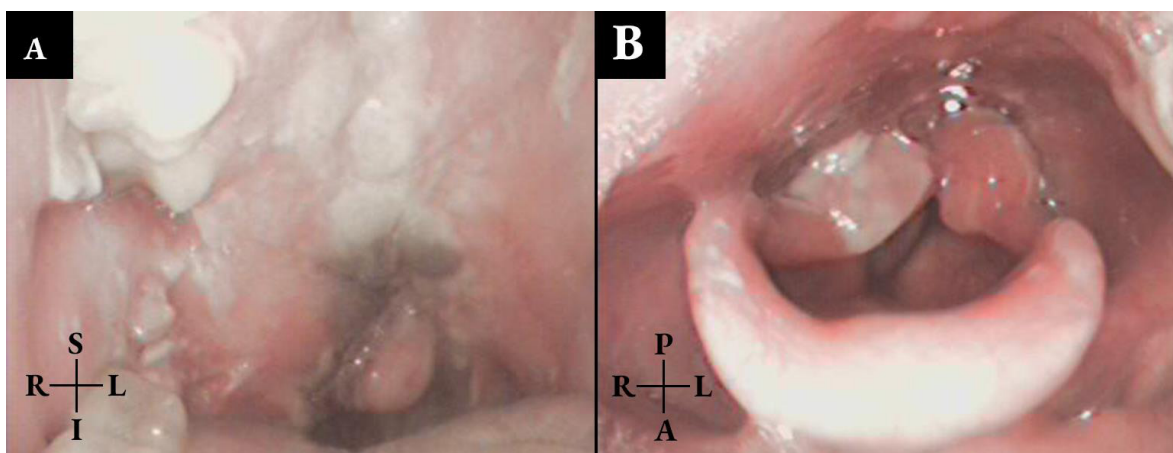
Case report

A 30-year-old female presented to the

Christchurch Hospital Emergency Department 8 hours after inhaling N_2O directly from a canister, with immediate pain followed by dysphonia and a sensation of throat swelling. She had also used cocaine. Oropharyngeal and flexible nasendoscopic examination showed oedema of the uvula, right soft palate, right aryepiglottic fold and both arytenoids, with a patent airway.

She was admitted to the otolaryngology ward and commenced on intravenous dexamethasone 8mg twice daily. The mucosa in the region of injury developed clearly demarcated necrotic areas over the following 48 hours, with improvement in oedema (Figure 1). The area of necrosis extended onto the right side of the hard palate, beyond the zone of injury identified on hospital admission. Her dysphonia resolved and she was discharged with analgesia when she could tolerate oral intake. Improvement in the appearance of the mucosa was observed at a planned review in the outpatient clinic 48 hours after discharge, with only mild palatal oedema and slough over the previously necrotic areas.

Figure 1: Endoscopic photos of the oral cavity and oropharynx (A) and larynx (B). Mucosal pallor indicating superficial necrosis affecting the palate, uvula and right arytenoid was observed on day 2 post-injury.



R = right; L = left; S = superior; I = inferior; P = posterior; A = anterior.

Discussion

Recreational N₂O use is common, but only four previous reports of associated cryogenic injuries were identified in the literature. Such injuries may therefore be under-reported. In the majority of cases, burns were caused by direct inhalation of pressurised gas. A further case report describes burns sustained from non-intentional inhalation from an exploding anaesthetic cylinder. Three of these five patients required intubation, with one subsequently requiring tracheostomy.⁴⁻⁸

N₂O is stored at approximately 30psi in whipped cream canisters and between 900 and 1,000psi in medical or automotive cylinders. While higher pressures are associated with more severe injuries, inhalation from lower-pressure canisters may still lead to clinically significant cryogenic burns.^{6,7} Burns to the skin are more commonly reported, usually of the inner thigh or hands caused by direct contact with the canister.⁹

Neurological complications of N₂O abuse are more widely recognised. A recent local case series described 12 patients with N₂O-associated myelopathy over a 7-year period, with a median consumption of 100 canisters per day. Three patients required ongoing assistance for activities of daily living at 1–3 months following hospital admission.² While N₂O is generally considered safe in limited doses, a significant minority of

recreational users experience serious harm.¹⁻⁸

Until September 2024, the sale of non-medical N₂O canisters in Aotearoa New Zealand was unrestricted, but the New Zealand Government recently advised that the *Psychoactive Substances Act 2013* would now apply to its sale for recreational inhalation. Those found to sell, offer to sell or possess to sell N₂O are now liable on conviction to imprisonment or large fines.¹⁰ This clarification of how legislation would be applied was intended to reduce the potential harms associated with N₂O abuse, despite clear evidence that prohibition's harms to individuals and society are greater than its benefits.¹¹⁻¹³ Interventions focussed on harm minimisation, such as decriminalising the sale and recreational use of N₂O, regulating its distribution, educating users on how to handle N₂O safely and distribution of delivery adjuncts like balloons are strategies that may reduce the harms of N₂O use more effectively than prohibition.^{1,12,13}

Conclusion

Cryogenic injuries to the upper aerodigestive tract are a potentially life-threatening but preventable complication of recreational N₂O inhalation. Improved awareness of such injuries may inform further legislative changes and public health interventions to minimise potential harms.

Table 1: Summary of cases reported in the literature of nitrous oxide-related airway burns.

Report	Source of N ₂ O	Recreational use	Additional substance use	Location of burn	Method of inhalation	Airway management
Rowson et al. 2023	Whipped cream canister	Yes	Amphetamines	Oropharynx	Direct	IV dexamethasone, IV antibiotics
Bagerman et al. 2020	Not stated	Yes	None	Arytenoids, vocal cords, arm	Indirect via balloon	Intubation (not stated if AFOI), IV dexamethasone
Chan et al. 2018	Automotive canister	Yes	LSD	Oral cavity, nasopharynx, oropharynx, supraglottis, mid-face, hand	Direct	AFOI, IV dexamethasone

Table 1 (continued): Summary of cases reported in the literature of nitrous oxide-related airway burns.

Report	Source of N ₂ O	Recreational use	Additional substance use	Location of burn	Method of inhalation	Airway management
Svartling et al. 1996	Anaesthetic cylinder	No	None	Pharynx, supraglottis, lower face	Direct	AFOI, tracheostomy, IV methylprednisolone, IV antibiotics
Rowbottom 1988	Anaesthetic cylinder	Yes	None	Lips, oral cavity, tongue, palate	Direct	Unknown

N₂O = nitrous oxide; IV = intravenous; AFOI = awake fiberoptic intubation; LSD = lysergic acid diethylamide.

COMPETING INTERESTS

Nil.

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