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Pneumomediastinum after laughing gas inhalation: not a laughing matter anymore—a case report

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Abstract

Introduction Nitrous oxide, popularly known as laughing gas, is a colorless gas with a faint, sweet odor, which has been used for recreational purposes since the nineteenth century. We present the case of an 18-year-old male who presented with spontaneous pneumomediastinum after nitrous oxide inhalation.

Case presentation An 18-year-old Caucasian British male patient presented to the emergency department complaining of sharp, central, pleuritic chest pain that radiated up to the throat and was worse on lying down. On examination, palpable surgical emphysema was noted on the neck and was noted on chest X-ray. A computed tomography of neck and chest was then performed, which revealed extensive pneumomediastinum tracking along the cervical, axillary, presternal, and anterior pericardial regions. A water-soluble contrast study was performed, which showed no evidence of esophageal perforation.

Conclusion Nitrous oxide is a substance that is widely and easily available and used recreationally for its euphoric effects. There are uncommon but significant side effects that can occur with its use; having an awareness of this and covering illicit drug use in history-taking will help guide further management plans.

Keywords Nitrous oxide, Spontaneous pneumomediastinum, Hamman sign, Laughing gas, Macklin effect, Case report

Introduction

Nitrous oxide (dinitrogen monoxide, N_2O), popularly known as laughing gas, is a colorless gas with a faint, sweet odor, which has been used for recreational purposes since the nineteenth century [1]. It can be inhaled from a balloon or from a canister, and in the UK [2], it was the second most prevalent recreational drug among young adults in 2019 [3]. In some rare cases, it has also led to the development of spontaneous pneumomediastinum [4]. We present the case of an 18-year-old male patient who presented with spontaneous pneumomediastinum after nitrous oxide inhalation.

Case presentation

An 18-year-old Caucasian British male patient presented to the emergency department complaining of sharp, central, pleuritic chest pain that radiated up to the throat and was worse when lying down. At presentation, he was alert, responsive, speaking in full sentences, and without airway compromise or respiratory distress. His respiratory rate was 18 breaths/minute, heart rate 62 beats/minute, blood pressure 133/62 mmHg, temperature 35.7 °C, and saturation of 97% on room air. He occasionally smokes tobacco and vapes. On examination, palpable surgical emphysema was noted on the neck and on chest X-ray (Fig. 1). Baseline investigations,

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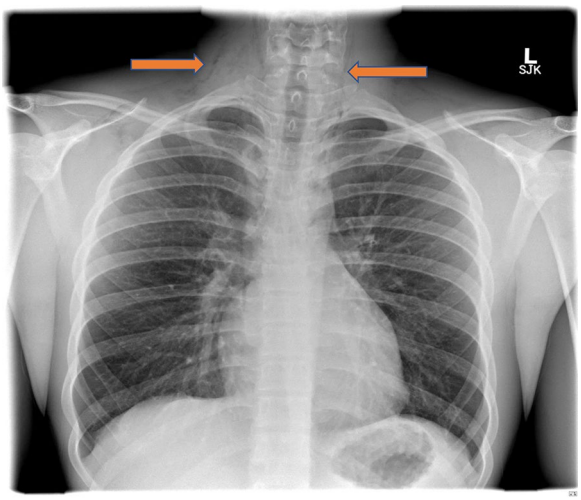

Fig. 1 Chest X-ray demonstrating subcutaneous emphysema in the neck region (both orange arrows)

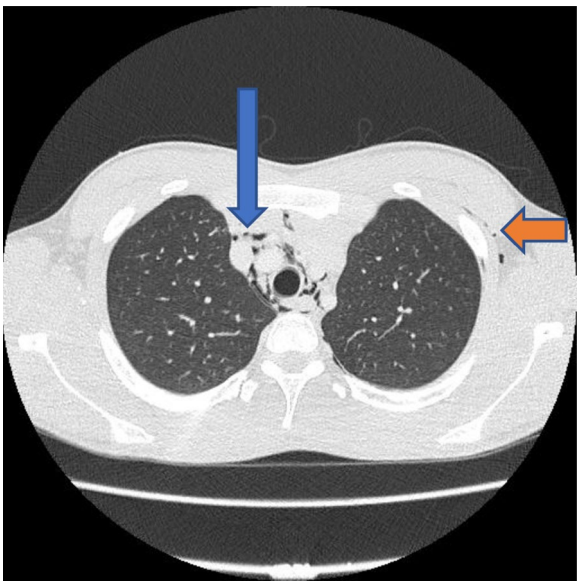

Fig. 2 Axial sections demonstrating pneumomediastinum (blue arrow) and subcutaneous emphysema (orange arrow)

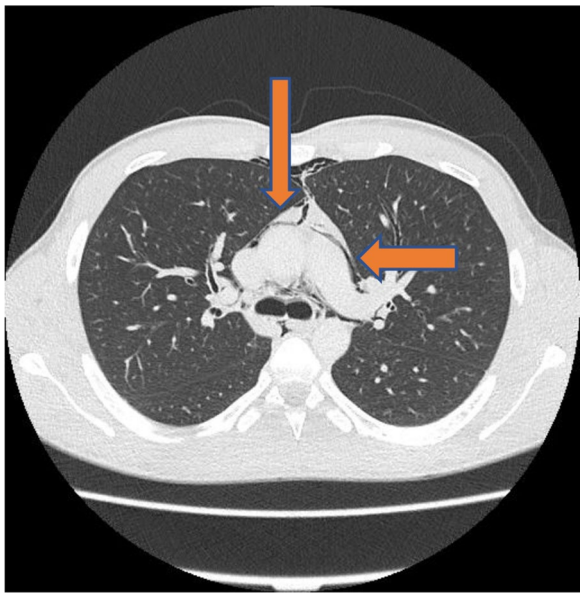

Fig. 3 Axial sections demonstrating pneumopericardium (both orange arrows)

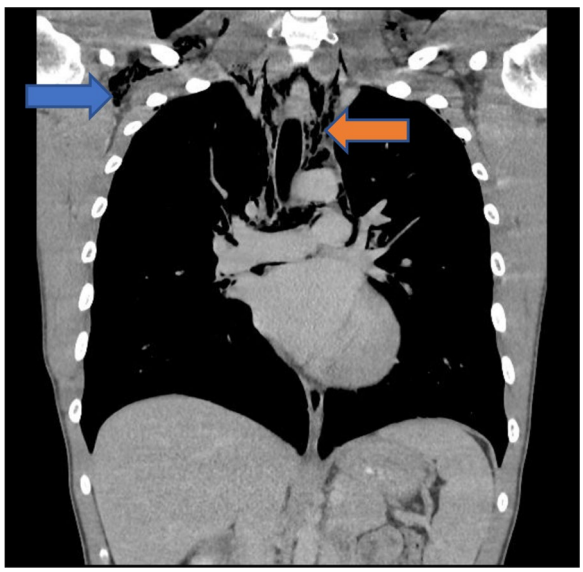

Fig. 4 Coronal section demonstrating pneumomediastinum (orange arrow) and subcutaneous emphysema in the neck region (blue arrow)

including arterial blood gas analysis and electrocardiogram, did not reveal any abnormalities. Troponin levels were within the normal range (3.9 ng/L). A computed tomography of the neck and thorax was then performed, which revealed extensive pneumomediastinum tracking along the cervical, axillary, presternal, and anterior pericardial regions (Figs. 2, 3, 4); the lungs were reported as clear, with no lymphadenopathy and no aggressive bony lesions. Following the diagnosis of a pneumomediastinum, the patient was admitted and the search for the cause commenced. On retrospective history-taking, he reported taking five balloons of nitrous oxide in the afternoon, along with other recreational drugs (cocaine and "ecstasy"). Then 6 hours later, he presented with this chest pain. After discussion with a tertiary center, a water-soluble contrast study was performed, which showed no evidence of esophageal perforation (Fig. 5). He remained hemodynamically stable throughout his

Fig. 5 Water-soluble contrast study demonstrating no esophageal leak

stay in the hospital. Despite awaiting further studies and ongoing medical care, the patient discharged himself against medical advice and was lost to follow-up.

Discussion

Spontaneous pneumomediastinum (SPM) was first reported by Hamman in 1939, when he described an audible crepitation occurring with the heartbeat on chest auscultation, known as "Hamman's sign" [5].

The initial differential diagnoses are broad and include pulmonary (embolus, pneumothorax, pneumonia, chest trauma), cardiac (pericarditis, ischemic heart disease), esophageal (Boerhaave's syndrome, Mallory Weiss tear), musculoskeletal (costochondritis, degenerative joint disease), and other rare causes. Among the uncommon causes, a vivid variety is observed, including childbirth, diabetic ketoacidosis, forceful coughing, Valsalva maneuver, and illicit drug use. However, most of these can be excluded with history-taking, examination, and radiological imaging.

The SPM associated with inhalational drug use could be explained by two phenomenon: (a) the Macklin effect, which is the rupture of terminal alveoli into the lung interstitium due to a pressure gradient, and (b) direct toxic action of heat and vasoconstriction [6–8]. Drug users routinely perform a forceful breath-holding-type maneuver during inhalation, which creates the pressure gradient, and this could explain the SPM in such cases [9].

Inhalational nitrous oxide has been used as an anesthetic agent previously and nowadays is being used extensively for recreational purposes owing to its euphoric effect [10]. There are no clear guidelines regarding management of SPM after inhaled nitrous oxide use, and there are only a handful of case reports or series regarding similar cases [9, 11, 12]. Considering the benign nature of the disease, it is still unclear whether these patients can be safely managed in an outpatient setting or whether they always require hospitalization. However, it is accepted that cases with unclear diagnosis or possibility of organ perforation require admission and further investigations. Going ahead, further research and formulation of a management guideline may help avoid undue investigations and hospital admissions.

Conclusion

Nitrous oxide is a substance that is widely and easily available and used recreationally for its euphoric effects. There are uncommon but significant side effects that can occur with its use; having an awareness of this and covering illicit drug use in history-taking will help guide further management plans.

Abbreviations

ng/L Nanograms per liter
SPM Spontaneous pneumomediastinum

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Author contributions

KJ was responsible for conceptualization. MG and KJ both contributed to the writing of the initial draft. AM was responsible for supervision and finalization of the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interests.

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