



ToxTalks:

A Bulletin for Healthcare Professionals Who Manage Poisoned Patients

Blue Ridge Poison Center

| University of Virginia Health

| December 2024

Inhalants



Overview

Inhalants are a group of volatile substances that produce psychoactive effects when inhaled. Commonly misused inhalants include toluene, nitrous oxide, and nitrites. These agents are widely available in household, industrial, or medical products, or can be purchased legally in head shops, leading to their misuse. Most intoxications present with nonspecific inebriation that without a high degree of suspicion or precise history can be difficult to diagnose and differentiate from other intoxicants. Despite this, each of these commonly misused inhalants can lead to significant morbidity and mortality in high doses or long-term use.

Pharmacology

While many hydrocarbons are misused as inhalants, toluene is one of the most common. Toluene is a volatile aromatic hydrocarbon that is lipophilic, allowing rapid absorption from the lungs and into the brain. It works similar to inhaled anesthetics

by modulating GABA and NMDA receptor activity to hyperpolarize central nervous system (CNS) neuronal membranes therefore making nerves less likely to activate.

Nitrous oxide is a nonhydrocarbon inhaled anesthetic used in medical and dental settings. It acts on the CNS predominantly by antagonizing NMDA receptors. It also inactivates vitamin B12 leading to neuropathies, cognitive deficits, and bone marrow suppression in chronic use.

Nitrites, such as amyl, butyl, and isobutyl nitrite, are volatile. Amyl nitrite was previously used medically for angina and cyanide poisoning. Nitrites are misused recreationally for euphoric and muscle-relaxing effects. Nitrites act by releasing nitric oxide, leading to smooth muscle relaxation and decreased vascular resistance, though its precise effects on the CNS are not well studied.

Continued next page

**Free. Fast. Expert help.
24 hours a day, 7 days a week.**

**POISON
HELP**
1-800-222-1222

Available Forms

Inhalants are insufflated through different methods such as sniffing, huffing, and bagging. Sniffing involves the inhalation of the substance directly from the container. Huffing entails pouring the liquid onto a fabric which is then placed over the mouth or nose. Bagging refers to instilling the substance into a plastic or paper bag and rebreathing from the bag repeatedly. Toluene is found in paint thinners, industrial solvents, spray paints, and some cleaning agents. Nitrous oxide is most often inhaled from consumer-grade cartridges, known as “whippets”, advertised for making whipped cream. Nitrites are packaged in small, crushable vials, known as “poppers”, sold legally in some stores as room deodorizers.



Nitrous oxide cannisters (“whippets”)

Clinical Effects

All three substances typically in acute intoxication produce CNS depression and inebriation with ataxia, slurred speech, confusion, and sometimes hallucination. This effect is typically short lived though many patients complain of headaches and dizziness once the desired euphoria resolves. Patients can have irritation of the skin around the mouth and nose depending on the formulation used. All hydrocarbons, which includes toluene, can produce aspiration pneumonitis that can be severe depending on the dose and volatility of the chemical. They can also lead to sudden cardiac dysrhythmias which can be lethal. The most commonly accepted theory is that these chemicals cause an irritation of the heart muscle which is then exacerbated by endogenous catecholamines when the user is startled such as being caught by parents or the police. Toluene also specifically can lead to hypokalemia and acidosis through renal toxicity resulting in a clinical presentation similar to a distal renal tubular acidosis. Due to the hypokalemia, these patients can often present with profound muscle weakness. Hydrocarbon misuse chronically can lead to leukoencephalopathy that has poor recovery even after cessation. Nitrous oxide when used heavily for long periods of produces a distal, axonal sensorimotor polyneuropathy. Amyl, butyl, and isobutyl nitrite are strong oxidants and in high doses leads to methemoglobinemia. Nitrites can also transiently increase intraocular pressure leading to eye pain and central, bilateral vision loss.

Diagnostic Evaluation

Routine urine drug screens do not test for inhalants or their metabolites. While specialized testing is available, such as hippuric acid which is a toluene metabolite, it is not typically useful in the acute setting. All patients with CNS depression from inhalants should be evaluated for hypoxemia with oxygen saturation monitoring; evidence of aspiration pneumonitis can be delayed several hours on lung imaging. For any patient with suspicion for hydrocarbon misuse, an electrocardiogram, electrolytes, and liver enzymes should be checked. With chronic misuse and neurological findings, an MRI may be required to determine if CNS damage has occurred. Patients with suspected nitrous oxide use should be screened for anemia and B12 levels. While typically B12 levels are low, patients with normal levels can still experience the damages of B12 deficiency such as neuropathy because detected B12 is not functional. Nerve studies can also be helpful to distinguish etiologies of neuropathy, though these are not usually obtained in the acute setting. Anyone suspected of nitrite misuse should be screened for methemoglobinemia with a blood gas with co-oximetry.

Continued next page

BRPC STAFF

Director

Christopher Holstege, MD

Nursing Director

John Gilday, MSN, NREMT-P

Medical Toxicologists

Andy Baer, MD
Nathan Charlton, MD
Aaron Frey, DO
Abigail Kerns, MD
Avery Michienzi, DO
Justin Rizer, MD

Medical Toxicology Fellows

Conner McDonald, MD
Sandra Nixon, MD
Scott Schmalzried, DO
Anna Zmuda, MD

Epidemiologist

Rita Farah, PharmD, MPH, PhD

Poison Specialists

Andy Anderson, RN
Stephanie Beach, BSN
Andre Berkin, BSN, CSPI
Michael Brookshire, BSN, CSPI
Jenni Goodwin, BSN, CSPI
Angela Hooe, FNP-C, BSN
Akash Pandit, PharmD
Lisa Turner, BSN, CSPI
Scott Warlitrner, MSN

Public Health Educator

Kristin Wenger, MA, BS

Administrative Specialists

Heather Collier
Debbie Philkil

Management

CNS depression from inhalants is typically short lived and can be managed supportively. Hypoxemia should be corrected immediately with oxygen therapy; more severe pneumonitis may require higher flow mechanisms. Hypokalemia from toluene should be corrected with supplementation. Nitrous oxide users should receive B12 supplementation and be counseled on cessation though neuropathies and cognitive deficits may have incomplete recovery. Methemoglobinemia from nitrite misuse may require methylene blue in select cases.

Summary

Toluene, nitrous oxide, and nitrites are commonly misused inhalants that can result in significant toxicities including CNS, cardiovascular, and hematologic effects. Early recognition and prompt management of acute toxicity can prevent life-threatening complications. Chronic use often results in adverse neurologic and cognitive effects which do not always improve.

