Chemical Emergency Medical Guideline

Information and recommendations for first responders and patients

Nitrogen dioxide

CAS No.: 10102-44-0

GHS symbols:

GHS05
Corrosive

GHS06
Acute toxicity

Signal word: Danger

Hazard statements:

H314	Causes severe skin burns and serious eye damage.
H330	Fatal if inhaled.

Overview

- A patient who is covered in nitrogen dioxide or whose clothing is covered in nitrogen dioxide may endanger other people through direct contact or through nitrogen dioxide gas emissions.
- Nitrogen dioxide and its vapors quickly cause burns on contact with tissues such as the eyes, skin and upper respiratory tract, causing symptoms such as irritation, burning, coughing, tightness in the chest and shortness of breath. Swelling of the larynx and accumulation of fluid in the lungs (shortness of breath, blue-red discoloration of the skin, lips and mucous membranes, sputum, coughing) may occur.
- Swallowing nitrogen dioxide can cause severe burns to the lips, mouth, throat, esophagus and stomach.
- There is no known specific antidote. Treatment depends on the extent of exposure and the symptoms.

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1. Information about the substance

Nitrogen dioxide (NO_2), CAS 10102-44-0
Synonym: Dinitrogen tetroxide (N_2O_4)
Up to 21°C, nitrogen dioxide is a colorless to yellow liquid. Above 21°C, it is a gas. The concentrated gas has a dark purple to black color. When diluted, it turns on a reddish-brown to yellow color. Nitrogen dioxide has a pungent, irritating odor at concentrations of 1-5ppm. Nitric acid is formed in contact with water. Nitrogen dioxide itself is not flammable, but it can increase the flammability of other materials or cause them to spontaneously combust. Nitrogen dioxide occurs naturally during the combustion of fossil fuels such as coal, oil or gas, as well as during the fermentation of grain in silos. It is also a component of smog. Nitrogen dioxide is released during the reaction between nitric acid and organic substances. It is also formed when nitric acid acts on metals, e.g. during electroplating, pickling and etching.

2. Exposition

2.1. Inhalation

The odor and irritant effect of nitrogen dioxide provide a clear warning of acutely dangerous concentrations.

2.2. Skin/eye contact

Direct contact of wet or damp skin with liquid nitrogen dioxide or concentrated vapors causes severe chemical burns. Nitrogen dioxide is hardly absorbed through the skin.

2.3. Ingestion

Ingestion of nitrogen dioxide can cause severe burns to the lips, mouth, throat, esophagus and stomach.

3. Acute health effects

Exposure to small amounts of nitrogen dioxide vapors usually causes irritation of the eyes, nose and throat, with tearing, dry throat and coughing. More pronounced exposure can cause severe respiratory problems, which can lead to pneumonia and ultimately death. Skin contact with liquid nitrogen dioxide can cause deep burns to the skin and mucous membranes, sometimes resulting in yellowing of the skin. Severe eye damage with clouding of the surface of the eye, penetration of the eyeball and subsequent blindness can result from exposure to nitrogen dioxide.

Inhalation of nitrogen dioxide usually causes dryness of the nose and throat and coughing. Inhalation of very high concentrations can result in swelling of the larynx and ultimately obstruction of the airways, leading to death. Shortness of breath with tightness in the chest and fluid accumulation in the lungs (shortness of breath, blue-red discoloration of the skin, lips and mucous membranes, sputum) can also occur with a delay of more than 24 hours.

Deep burns to the skin and mucous membranes can occur through skin contact with concentrated nitrogen dioxide; sometimes the skin turns yellow. Contact with less concentrated vapors can cause burning pain, redness and inflammation.

Severe eye burns with clouding of the surface of the eye and even penetration of the eyeball with subsequent blindness can result from exposure to liquid nitrogen dioxide. Low concentrations of the vapor or smoke cause painful discomfort, spasmodic blinking or involuntary closing of the eyelids, redness and tearing.

A single, short-term exposure to low concentrations of nitrogen dioxide, from which the affected person recovers quickly, does not normally cause delayed or lasting damage to health. After inhaling relevant amounts of nitrogen dioxide, permanent respiratory disorders and increased susceptibility to lung infections have been reported.

4. Measures

4.1. Self-protection of first responders

If there is a suspicion that the area the helper must enter contains nitrogen dioxide, a self-contained breathing apparatus and a chemical protection suit must be worn. Contaminated equipment should not be used.
A patient who is covered in nitrogen dioxide or whose clothing is contaminated with it may pose a risk to others through direct contact or through evaporating nitrogen dioxide.

4.2. Rescue

Patients should be removed from the danger zone immediately. If they are unable to walk unaided, they should be removed from the danger zone quickly using appropriate means, taking care to protect themselves. The "A, B, C procedure" then has absolute priority.

A) Clear the airways (check for blockages caused by the tongue or foreign objects)
B) Ventilation (check the patient's breathing, if necessary, begin ventilation with adequate self-protection, e.g. breathing mask)
C) Circulation (begin resuscitation for any person who does not respond to verbal commands and is not breathing normally)

4.3. Cleaning

Patients who have only been exposed to nitrogen dioxide vapors and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others.
If possible, patients should assist with their own decontamination. If liquid nitrogen dioxide has been exposed and clothing is contaminated, it must be removed and securely wrapped.
If the eyes have been exposed to nitrogen dioxide or if there is eye irritation, they must be rinsed with water or a neutral saline solution for 15 minutes. Contact lenses must be removed, if possible, without causing additional danger to the eye. Other important first aid measures must be continued during this time.
Rinse affected skin and hair with water for at least 15 minutes. Protect eyes while rinsing. Continue other important first aid measures during this time.

4.4. Further measures

Do not induce vomiting if nitrogen dioxide has been swallowed. Anyone who may have been exposed to nitrogen dioxide should seek medical attention immediately.

4.5. Instructions for further rules of conduct

Call your family doctor or the emergency department of the nearest hospital to see if any abnormalities or symptoms occur within the next 24 hours, in particular:

- Coughing, wheezing or whistling breath
- Difficulty breathing or shortness of breath
- Increased pain or abnormalities in the affected skin areas or eyes
- Pain or tightness in the chest area

5. References

Berufsgenossenschaft der chemischen Industrie, Hrsg. Salpetersäure / Stickstoffoxide. Heidelberg: Jedermann-Verlag, 1987. (Merkblätter für gefährliche Arbeitsstoffe; M 014.)

Buttgereit F, Dimmeler S, Neugebauer E, Burmester GR. Wirkungsmechanismen der hochdosierten Glucocorticoidtherapie. Dtsch Med Wschr 1996; 121: 248-252.

Diller WF. Anmerkungen zum Unglück in Bhopal. Dtsch Med Wschr 1985; 110: 1749-1751.

Ellenhorn MJ, Schonwald S, Ordog G, Wasserberger J. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore: Williams & Wilkins, 1997: 1461.

Goldfrank LR, Flomenbaum NE, Lewin NA, Weisman RS, Howland MA, Hoffman RS. Toxicologic Emergencies. 6th ed. Norwalk: Appleton & Lange, 1998: 1192, 1194, 1526, 1531.

Grant WM, Schuman JS. Toxicology of the Eye. 4th ed. Springfield: Charles C Thomas Publisher, 1993: 1049-1050.

Thiess AM, Schmitz T. Gesundheitsschädigungen und Vergiftungen durch Einwirkung von Reizstoffen auf die oberen und mittleren Atemwege. Sichere Arbeit 1969; 3/69: 11-18.

U.S. Department of Health & Human Services - Agency for Toxic Substances and Disease Registry, ed. Nitrogen Oxides. Atlanta, 1994. (Managing Hazardous Materials Incidents; vol III.)

Yockey CC, Eden BM, Byrd RB. The McConnell Missile Accident – Clinical Spectrum of Nitrogen Dioxide Exposure. J Am Med Assoc 1980; 244: 1221-1223.

Foncerrada G et al, Safety of Nebulized Epinephrine in Smoke Inhalation Injury, J Burn Care Res 2017;38:396–402

Walker PGF et al, Diagnosis and management of inhalation injury: an updated review, Critical Care (2015) 19:351

Olasveengen TM, Semeraro F, et. Al: European Resuscitation Council Guidelines 2021: Basic Life Support. Resuscitation 2021, 161: 98-114

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