Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Nitric acid

CAS No.: 7697-37-2

GHS symbols:

GHS05
Corrosive

GHS06
Acute toxicity

Signal word: Danger

Hazard statement:

H314 Causes severe skin burns and serious eye damage.

Overview

- A patient who is covered in nitric acid or whose clothing is covered in nitric acid may endanger other people through direct contact or through nitric acid vapors or fumes.
- Nitric acid and its vapors or fumes quickly cause burns on contact with tissues such as the eyes, skin and upper respiratory tract, causing symptoms such as irritation, burning, coughing, chest tightness and shortness of breath. Bronchospasm and toxic pulmonary oedema (shortness of breath, cyanosis, sputum, coughing) may occur.
- Swallowing nitric acid 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

Nitric acid (HNO_3 , CAS 7697-37-2)
At room temperature, nitric acid is a colorless yellow or brown-red liquid with a pungent odor. The color depends on the concentration of nitrogen oxides, especially nitrogen dioxide, which is formed when exposed to light. This so-called fuming nitric acid also develops reddish-brown vapors from nitrogen oxides and nitric acid below its boiling point of 83 °C. Nitric acid can also be formed in a photochemical reaction in smog from nitrogen oxides and hydrocarbons. Nitric acid itself is not flammable, but it can increase the flammability of other materials or cause them to spontaneously combust. Nitric acid is soluble in water.
Nitric acid is used in the manufacture of fertilizers, ammunition and explosives, pesticides, dyes and medicines, especially in the production of organic and inorganic nitrates. It is also used in etching and cleaning metals and in electroplating.

2. Exposition

2.1. Inhalation

The odor and irritant effect of nitric acid provide a clear warning of acutely dangerous concentrations.

2.2. Skin/eye contact

Direct contact of wet or damp skin with liquid nitric acid, concentrated vapors or fumes causes severe burns. Nitric acid is hardly absorbed through the skin.

2.3. Ingestion

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

3. Acute health effects

3.1. Blood

Methemoglobinemia may occur only after very high exposure, but usually only to an extent that does not require specific treatment. ***For further information on the treatment of methemoglobinemia, see BASF CEMG Professional for Aniline.***

3.2. Respiratory

Exposure to nitric acid usually causes dryness of the nose and throat and coughing. Inhalation of very high concentrations can lead to bronchospasm and ultimately to airway obstruction and death. The development of breathing difficulties with chest tightness and toxic pulmonary oedema (shortness of breath, cyanosis, sputum, coughing) can occur with a delay of more than 24 hours.

3.3. Skin contact

Deep chemical burns to the skin and mucous membranes can occur through contact with concentrated nitric acid; sometimes the skin turns yellow. Contact with less concentrated vapors or fumes of nitric acid can cause burning pain, redness and inflammation.

3.4. Gastrointestinal tract

Abdominal pain, nausea and vomiting may occur. If swallowed, diffuse chemical burns to the mucous membranes may affect the entire gastrointestinal tract.

3.5. Kidneys

Acid-base balance disorders and acute renal failure may occur.

3.6. Eye contact

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

3.7. Possible consequences

Damage to the skin, eyes and mucous membranes caused by nitric acid burns can be irreversible, e.g. gangrene, blindness or esophageal stenosis. Complete recovery usually occurs after inhalation; in individual cases, symptoms and restrictions of lung function may persist. Permanent restrictive and obstructive lung diseases may remain after bronchiolar damage. Destruction of lung tissue or scarring can lead to chronic dilation of the bronchi and increased susceptibility to infections. Chronic or prolonged exposure may result in an increased risk of yellowing or erosion of the teeth.

4. Measures

4.1. Self-protection of first aiders

If there is a suspicion that the area the helper must enter may contain dangerous concentrations of nitric acid (see below), a self-contained breathing apparatus and a chemical protection suit must be worn. Contaminated equipment must not be used.
A patient who is wet with nitric acid or whose clothing is wet with nitric acid may endanger other people through direct contact or through nitric acid vapors or fumes.

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" 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 on any person who does not respond to verbal commands and is not breathing normally)

"CRASH" decontamination

- Rescue patients contaminated with nitric acid who are unconscious or unable to move (critically ill/injured patients according to the ABCDE scheme) from the immediate danger zone, taking care to protect yourself with suitable personal protective equipment
- If necessary, perform emergency measures ("basic life support"; e.g. bleeding control using a tourniquet, chest compressions, etc.)
- At a suitable location outside the danger zone, completely undress the contaminated patient using an emergency rescue knife, taking care to protect yourself (duration: approx. 1 minute).
- Shower/rinse with plenty of water (duration: approx. 1 minute).
- Transfer to a clean stretcher. Ensure body heat is maintained
- Transport/handover to the emergency services/emergency doctor (duration: approx. 1 minute).

4.3. Cleaning

If possible, patients should help with their own cleaning. If liquid nitric acid has come into contact with clothing and contaminated it, the clothing must be removed and securely wrapped.
If the eyes have been exposed to nitric acid or if there is eye irritation, rinse with water or neutral saline solution for at least 15 minutes. If eye rinsing is impeded by spasmodic eyelid closure, the use of a local anesthetic solution (e.g. lidocaine, oxybuprocaine) may be considered. Remove any contact lenses, if possible, without causing additional danger to the eye.
Rinse affected skin and hair with water for at least 15 minutes. Protect eyes while rinsing.

4.4. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
The following measures are recommended if the exposure concentration is 10ppm or more, if symptoms such as eye irritation or pulmonary symptoms are present, or if the exposure concentration cannot be estimated but exposure is likely:

- Oxygen administration
- Administration of 8 sprays of beclomethasone (800µg beclomethasone dipropionate) from a metered dose inhaler.

If there are signs of airway constriction (e.g. bronchospasm or stridor)

- Nebulization of adrenalin (epinephrine): mix 2mg adrenalin (2ml) with 3ml 0.9% NaCl and administer via a nebulizer mask
- Administration of a ß2-selective adrenoceptor agonist, e.g. four puffs of terbutaline or salbutamol or fenoterol (one puff usually contains 0.25mg terbutaline sulphate; or 0.1mg salbutamol; or 0.2mg fenoterol); this can be repeated once after 10 minutes.

Alternatively, 2.5mg salbutamol and 0.5mg ipratropium bromide can be administered via a nebulizer mask.
If inhalation is not possible, administer terbutaline sulphate (0.25mg to 0.5mg) subcutaneously or salbutamol (0.2mg to 0.4mg over 15 minutes) intravenously.
Intravenous administration of 250mg methylprednisolone (or an equivalent steroid dose).

If there are signs of toxic pulmonary oedema (e.g. frothy sputum, moist rales)

- CPAP therapy
- Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose)
  In case of (increasing) respiratory insufficiency, advanced airway management, e.g. endotracheal intubation or coniotomy if necessary.

Note: The efficacy of corticosteroid administration has not yet been proven in controlled clinical trials.

Exposure to the eyes can cause serious damage; this should also be treated as a burn. Consult an ophthalmologist immediately.

Note: Any exposure to liquid nitric acid in the facial area must be considered serious.

If nitric acid is swallowed, do not induce vomiting.
If there are signs or symptoms of esophageal irritation or burns, the patient should be taken to an endoscopy center as soon as possible. Endoscopy to determine the extent of the damage (suspected gastrointestinal necrosis or perforation?) should be considered.
Only if a significant dose was swallowed less than 30 minutes before the patient's endoscopic examination and perforation can be ruled out should immediate gastric lavage be considered.

Patients who have been exposed to high concentrations or have swallowed nitric acid, as well as patients without exposure measurements but with a high degree of suspicion of exposure, should be transported immediately to a hospital with intensive care facilities.

4.5. Further action and treatment

In addition to taking medical history, performing a physical examination and checking vital signs, pulse oximetry, a chest X-ray and spirometry should be carried out. Routine laboratory tests should include complete blood count, glucose and electrolytes. Arterial blood gases and methemoglobin concentrations should be determined in symptomatic patients to determine the extent of any acidosis or methemoglobinemia.

Radiological signs of pulmonary oedema – enlargement of the hila, typical, centrally accentuated, patchy shadows on the chest X-ray – are late signs that often cannot be detected until 24 hours after exposure. The X-ray is typically normal on initial presentation at the hospital, even after inhalation of a relevant dose.

Patients with possible exposure or with significant complaints or symptoms should be monitored for an appropriate period and re-examined before any consequential damage to health can be ruled out. Delayed effects in patients with only mild, rapidly subsiding symptoms of the upper respiratory tract (mild burning or coughing) are unlikely.
If oxygen saturation falls below 90%, arterial blood gas concentrations must be checked immediately and the chest X-ray repeated. If blood gas concentrations deteriorate and/or the chest X-ray shows signs of toxic pulmonary oedema, oxygen should be administered via a mask. If deterioration manifests (especially in the case of tachypnoea (>30/min) and a simultaneous decrease in carbon dioxide partial pressure), CPAP therapy should be started within the first 24 hours after exposure.

In the event of pulmonary oedema developing, fluid intake and excretion as well as electrolytes should be closely monitored. A positive balance should be avoided. To optimize fluid management, the insertion of a central venous catheter should be considered.
If signs of pulmonary oedema persist, intravenous administration of methylprednisolone (or an equivalent steroid) should be continued at intervals of 8 to 12 hours.

Prophylactic antibiotic administration is not routinely recommended but may be considered based on the results of sputum cultures. Pneumonia may occur as a complication of severe pulmonary edema.

4.6. Discharge of the patient / instructions for further rules of conduct

Clinically asymptomatic patients who have been exposed to only low concentrations of nitric acid and who show no abnormal clinical findings and no signs of toxic effects after an appropriate follow-up period may be discharged under the following circumstances:

- Information and recommendations for patients with instructions for further action were provided
  The patient was instructed to seek immediate medical attention if any health problems arise.
- The patient is aware of and understands the toxic effects of nitric acid.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Heavy physical work should not be carried out in the following 24 hours.
- Do not smoke or be around cigarette smoke for at least 72 hours; smoke can worsen lung function.
- Patients with serious skin or eye injuries should be re-examined after 24 hours.
- Spirometry should be repeated at regular intervals after discharge until the values have returned to the patient's baseline values prior to exposure.

5. References

Berufsgenossenschaft der chemischen Industrie (German Social Accident Insurance Institution for the Chemical Industry), ed. Nitric acid / nitrogen oxides. Heidelberg: Jedermann-Verlag, 1987. (Information sheets for hazardous substances; M 014.)

Buttgereit F, Dimmeler S, Neugebauer E, Burmester GR. Mechanisms of action of high-dose glucocorticoid therapy. Dtsch Med Wschr 1996; 121: 248-252.

Diller WF. Comments on the disaster 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: 1083.

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

Grant WM, Schuman JS. Toxicology of the Eye. 4th ed. Springfield: Charles C Thomas Publisher, 1993: 1045-1046.

Thiess AM, Schmitz T. Health hazards and poisoning caused by irritants affecting the upper and middle respiratory tract. Safe Work 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.)

Foncerrada G et al, Safety of Nebulised 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

Administrative Information

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