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Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Hydrazine

CAS No.: 302-01-2; 10217-52-4; 7803-57-8

GHS symbols:

GHS05
Corrosive

GHS06
Acute toxicity

GHS08
Health hazard

Signal word: Danger

Hazard statements:

H314	Causes severe skin burns and serious eye damage.
H317	May cause allergic skin reactions.
H330	Fatal if inhaled.
H350	May cause cancer.
H301+H311	Toxic if swallowed or in contact with skin.

Overview

- Before paramedics/emergency doctors on site approach a patient, who has been or is exposed to hydrazine, they must ensure that there is no danger to themselves from hydrazine.
- There is no danger from contact with patients who have only been exposed to hydrazine gas. A patient who is wet with hydrazine-containing liquid, or whose clothing is wet with it, may endanger other people through direct contact or through hydrazine gas emissions.
- Hydrazine is highly irritating as a gas or liquid and can cause severe burns to the eyes and skin.
- Inhalation can cause irritation of the respiratory tract with swelling of the nasal and throat mucosa, coughing and shortness of breath. Bronchospasm and signs of toxic pulmonary oedema (shortness of breath, cyanosis, sputum, coughing) may occur.
- General symptoms such as nausea, vomiting, stomach pain, central nervous system disorders, tremors, ataxia and convulsions may occur.
- Laboratory tests may reveal hemolysis, acidosis and methemoglobinemia.

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1. Information on the substance

Hydrazine (NH_2-NH_2), CAS; 302-01-2
Hydrazine hydrate (N_2H_4-H_2O), CAS: 10217-52-4 (contains 55% hydrazine w/w); CAS: 7803-57-8 (contains 64% hydrazine w/w)
Synonyms: Diamine, Diamine
At room temperature, hydrazine is a colorless, fuming, oily liquid with an ammonia-like, fishy odor. It decomposes into ammonia, hydrogen and nitrogen oxides, is flammable and explosive (boiling point 113.5°C, flash point 37.8°C).
Hydrazine has been used as a rocket fuel and corrosion inhibitor and is used as an intermediate product and in polyurethane production.

2. Exposition

2.1. Inhalation

Exposure to hydrazine occurs mainly through inhalation. The odor and irritant effect of hydrazine serve as a clear warning. Breathing difficulties, including shortness of breath,
coughing, constriction of the upper respiratory tract and bronchi, and accumulation of fluid in the lungs may occur.

2.2. Skin/eye contact

Hydrazine is absorbed quickly and in significant quantities. Direct contact of the eyes or moist skin with liquid hydrazine or concentrated gas causes severe chemical burns. Allergic skin reactions have been observed.

2.3. Ingestion

Accidental ingestion of hydrazine is unlikely. If swallowed, liquid hydrazine can cause severe damage through chemical burns to the mouth, throat and stomach.

3. Acute health effects

Hydrazine gas generally causes irritation to the eyes, nose and throat.
Short-term inhalation can lead to coughing, respiratory tract irritation, tremors, ataxia, convulsions, haemolysis, acidosis and methaemoglobinemia. Chronic exposure can lead to kidney and liver damage. Hydrazine has a sensitising effect and is possibly carcinogenic.

3.1. Dose-response relationship

Hydrazine concentration		Effect/effects
0.01 ppm	-	TLV-TWA (ACGIH, USA)
3 - 4 ppm	-	Odor threshold
50 ppm	-	IDLH (NIOSH, USA)
0.1 ppm	-	AEGL-1 10 minutes and 30 minutes
23 ppm	-	AEGL-2 10 minutes
16 ppm	-	AEGL-2 30 minutes
64 ppm	-	AEGL-3 10 minutes
45 ppm	-	AEGL-3 30 minutes

TLV: Threshold limit value → Air concentration below which it is assumed that almost all workers can be repeatedly exposed to this concentration day after day throughout their working lives without this leading to harmful effects on their health.
TWA: Time weighted average
ACGIH: American Conference of Governmental Industrial Hygienists
IDLH: Immediately dangerous to life and health
NIOSH: National Institute for Occupational Safety and Health
AEGL-1 (acute exposure guideline levels) of the US Environmental Protection Agency (EPA): Guideline values for acute exposure. Concentration of a substance in the air above which the general population, including sensitive individuals, may experience noticeable discomfort, irritation or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are temporary and reversible upon cessation of exposure.
AEGL-2: Concentration of a substance in the air above which the general population, including sensitive individuals, can be expected to suffer irreversible or other serious and long-lasting health effects or to be impaired in their ability to escape.
AEGL-3: Concentration of a substance in the air above which life-threatening health effects or death are expected to occur in the general population, including sensitive individuals.

3.2. Respiratory tract

Short-term inhalation may cause coughing, breathing difficulties, tremors, ataxia, convulsions and methemoglobinemia.

3.3. Skin contact

Skin contact with hydrazine can cause severe damage.

3.4. Possible consequences

After acute exposure, symptoms usually subside, which in some cases can take weeks to months. Complete recovery is usually achieved. Increased sensitivity to irritants may persist and cause bronchospasm or chronic bronchitis. Such "reactive airways dysfunction syndrome" (RADS) may persist for several years. Destruction of lung tissue or scarring can lead to chronic bronchial dilation and increased susceptibility to infections. Sensitization with subsequent allergic reaction upon renewed contact has been described.

3.5. Carcinogenicity

According to Directive EC 1272/2008, hydrazine is classified as follows: Carc. 1B (probably carcinogenic to humans; suspected based on animal studies).

4. Measures

4.1. Self-protection of first aiders

If there is suspicion that the area the helper must enter contains hydrazine in an acutely dangerous concentration (0.1ppm or more), a self-contained breathing apparatus and a chemical protection suit must be worn.
There is no danger from contact with patients who have only been exposed to hydrazine gas. A patient who is wet with hydrazine-containing liquid, or whose clothing is wet with it, may endanger other people through direct contact or through hydrazine gas emissions.

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 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 hydrazine gas and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others. If possible, patients should assist in their own cleaning. If liquid hydrazine has been exposed and clothing is contaminated, it must be removed and securely wrapped.

If the eyes have been exposed to hydrazine or if eye irritation is present, 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. Continue other important emergency measures during this time. Protect eyes while rinsing.

4.4. Initial treatment (preclinical or clinical)

The following measures are recommended if the hydrazine gas concentration is 0.1 ppm or higher and symptoms such as eye irritation or pulmonary symptoms are present:

- 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 NaCl 0.9% and administer via a nebulizer mask.
- Administration of a $ß_2$ -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 1000mg methylprednisolone (or an equivalent steroid dose)
  In case of (increasing) respiratory insufficiency, advanced airway management, e.g. endotracheal intubation or, if necessary, coniotomy.

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

Skin contact with hydrazine can cause severe damage; this should be treated like burns: adequate fluid administration, analgesic therapy, maintenance of body temperature, covering the affected skin area with a sterile dressing.
Exposure of the eyes can also cause serious damage; this should also be treated as a chemical burn. Consult an ophthalmologist immediately.

Note: Any contact with liquid hydrazine in the facial area can have serious consequences.

Symptomatic patients with an exposure concentration of 0.1ppm or more should be transported immediately to a hospital with intensive care facilities.

4.5. Antidote treatment

For neurological symptoms: Intravenous access and intravenous administration of pyridoxine (vitamin B6) over 5 to 10 minutes (25mg/kg body weight).

Pyridoxine 2mg/kg i.m. or i.v. was combined with benzodiazepine after hydrazine exposure to treat seizures, impaired consciousness and lactic acidosis. Depending on the patient's clinical condition, pyridoxine can be administered repeatedly up to a maximum dose of 5 g/day. Adverse effects are rare in acute treatment. Impaired consciousness may occur when more than 5g of pyridoxine is administered per day.
Immediate transport to a hospital with intensive care facilities is required.

Symptomatic methemoglobinemia should be treated with toluidine blue (provided there is no glucose-6-phosphate dehydrogenase deficiency). Administer 2 to 4mg/kg body weight of toluidine blue intravenously over 5 minutes. If toluidine blue is not available, methylene blue should be injected intravenously at a dose of 1-2mg/kg body weight over 5 to 10 minutes. The administration of toluidine blue can be repeated once after 30 minutes, and that of methylene blue after 60 minutes, depending on the methemoglobin level and the patient's clinical condition.

4.6. Further procedure and treatment

In addition to taking a medical history, performing a physical examination and checking vital signs, a complete blood count, hemoglobin, methemoglobin and glucose levels should be determined and a urine analysis performed. Fluid intake and output as well as electrolytes should be closely monitored.

Clear radiological signs of pulmonary oedema – enlargement of the hili, typical, centrally emphasized, 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 still normal at the 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 repeatedly 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 becomes apparent (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.

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

Clinically asymptomatic patients who have been exposed to a concentration of less than 0.1 ppm (depending on the duration of exposure) and who show no abnormal clinical findings and no signs of toxic effects after an appropriate follow-up period may be discharged from hospital under the following circumstances:

- Information and recommendations for patients with instructions for further action were provided verbally and in writing. The patient was advised to seek immediate medical attention if any health problems arise.
- The patient is aware of and understands the toxic effects of hydrazine.
- 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 done in the following 24 hours.
- Do not smoke or be exposed to cigarette smoke for at least 72 hours; smoke can impair lung function.
- Patients with 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

American Conference of Governmental Industrial Hygienists (ACGIH). Documentation of the Threshold Limit values, Cincinnati, 2001. Hydrazine, 1-6.

Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, 2013. TOXFAQS, Hydrazine, 1,1-Dimethylhydrazine and 1,2-Dimethylhydrazine, 1-2.

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

Centers for Disease Control and Prevention, NIOSH, International Chemical Safety Cards, Atlanta, 1995. Hydrazine, ICSC: 0281.

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

Flanagan RJ, Jones AL. Antidotes, Taylor & Francis, London, 2001. Pyridoxine, 136-138.

Plunkett ER. Handbook of Industrial Toxicology (3rd ed.), Edward Arnold, London, 1987. Hydrazines, 288-289.

Thomson Reuters, Inc., 2017. HAZARDTEXT ® - Hazard Management, Hydrazines, 1-27.

Thomson Reuters, Inc., 2017. MEDITEXT ® - Medical Management, Hydrazines, 1-19.

Makarovsky I, Markel G, Dushnitsky T, Eisenkraft A. Hydrazine – The Space Era Agent IMAJ 2008; 10:302–306

Heynemeyer G, Fabian U, Der Vergiftungs- und Drogennotfall, Ullstein Mosby, Berlin/Wiesbaden, 1997. Pyridoxin, 116-117.

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

Administrative Information

Document Type	Chemical Emergency Medical Guideline
Number of Version	DE.1.0.0
Initial Publication	01.01.2026
Next Revision	2029
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