Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Aliphatic amines

CAS No.: 74-89-5; 124-40-3; 75-50-3; 75-04-7; 109-89-7; 121-44-8

GHS symbols:

GHS05
Corrosive

GHS06
Acute toxicity

Signal word: Danger

Hazard statements:

For detailed information on the H statements for the individual substances within this group, it is recommended to consult the relevant safety data sheets provided by the distributor or official databases (e.g. https://echa.europa.eu/de/search-for-chemicals).

Overview

- These guidelines are based on information about the aliphatic amines mono-, di-, trimethylamine and mono-, di- and triethylamine. Recommendations for other aliphatic amines are similar in many respects. However, these guidelines do not cover any special considerations that may apply to other aliphatic amines.
- There is no danger from contact with patients who have only been exposed to gas or vapor from aliphatic amines. A patient who is wet with liquid aliphatic amines, or whose clothing is wet with liquid aliphatic amines, may endanger other people through direct contact or through outgassing/evaporating aliphatic amines.
- Aliphatic amines are highly irritating as gases, vapors and liquids and can cause severe burns to the eyes and skin.
- Irritation of the respiratory tract can result in swelling of the nasal and throat mucosa, coughing and shortness of breath. Bronchospasm and signs of pulmonary oedema (shortness of breath, cyanosis, sputum, coughing) may occur.
- 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

Aliphatic amines: (mono)methylamine (CH_3NH_2, CAS: 74-89-5), dimethylamine (($CH_{32}NH$, CAS: 124-40-3), trimethylamine (($CH_{(3)_3}$ N, CAS: 75-50-3), (mono-)ethylamines ((CH_2 CH_2 NH_2, CAS: 75-04-7), diethylamine ((CH_3 CH_2 $)_2$ NH, CAS: 109-89-7), triethylamine ((CH_3 CH_2 $)_3$N, CAS: 121-44-8)
The lower aliphatic amines discussed here are strongly alkaline derivatives of ammonia.
Methylamine and ethylamine are colorless gases at room temperature, while the other aliphatic amines are highly volatile liquids. The amines are highly to moderately soluble in water. All have a characteristic unpleasant odor. At high concentrations, this odor is like that of ammonia, while at lower concentrations it is fishy.
Aliphatic amines are widely used as starting materials for chemical synthesis, as intermediates and solvents in the manufacture of plastics, pesticides, explosives, dyes, surfactants, catalysts and other chemicals.

2. Exposition

2.1. Inhalation

Exposure to aliphatic amines occurs mainly through inhalation. The odor and irritant effect of aliphatic amines serve as a clear warning. However, the sense of smell can become dulled, meaning that low concentrations are hardly noticeable after prolonged exposure.

2.2. Skin/eye contact

Even low concentrations of aliphatic amines cause immediate irritation to the eyes and moist skin. Direct contact of the eyes or moist skin with liquid aliphatic amines, concentrated gas or vapor causes severe chemical burns.

2.3. Ingestion

Accidental ingestion of aliphatic amines is unlikely. Solutions containing aliphatic amines can cause severe damage through chemical burns to the mouth, throat and stomach if swallowed.

3. Acute health effects

3.1. Dose-response relationship

Concentration of aliphatic amines		Effect/effects
0.01 - 20 ppm	-	Perception of a fishy odor (tolerance development)
5 - 25 ppm	-	Slight visual disturbances
10 - 100 ppm	-	Temporary irritation of the mucous membranes
100 - 200 ppm	-	Odor becomes ammonia-like
50 - 500 ppm	-	Significant irritation of skin, eyes and upper respiratory tract with conjunctivitis, feeling of suffocation

3.2. Respiratory tract

Exposure to aliphatic amines generally causes irritation of the eyes, nose and throat. Breathing difficulties, including shortness of breath with coughing, constriction of the upper respiratory tract and bronchi, and pulmonary oedema may occur.

3.3. Skin/eye contact

If the skin is wet or damp, contact with gases or vapors from aliphatic amines can cause burning pain, inflammation, blisters and ulcers. Contact with pressurized liquid aliphatic amines may result in frostbite.

Low concentrations of gas or vapor in the eye can cause painless corneal oedema with blurred vision, grey-blue coloration and halos. Higher concentrations or contact with liquid aliphatic amines can cause conjunctival hemorrhages, corneal opacities and corneal inflammation. Other symptoms such as severe burning, spasmodic blinking or closing of the eyelids, redness and tearing may occur.

3.4. Other

After inhalation, temporary headaches, nausea, weakness and restlessness may also occur.

3.5. Possible consequences

After acute exposure, symptoms usually subside, which in some cases can take weeks to months. Complete recovery is usually achieved. Survivors of severe inhalation damage may suffer from chronic lung disease. Eye contact with liquid aliphatic amines can result in irreversible eye damage and visual impairment.

4. Measures

4.1. Self-protection of first aiders

If there is a suspicion that the area the helper must enter contains aliphatic amines in a concentration of 50ppm or more, a self-contained breathing apparatus and a chemical protection suit must be worn. Contaminated equipment should not be used.
Only for acute rescue measures can exposure of helpers without protective equipment to aliphatic amines in concentrations below 50ppm be accepted for a short period of time.
There is no danger from contact with patients who have only been exposed to gas or vapor from aliphatic amines. A patient who is wet with liquid aliphatic amines, or whose clothing is wet with liquid aliphatic amines, may endanger other people through direct contact or through outgassing/evaporating aliphatic amines.

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 gas or vapor from aliphatic amines 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 decontamination. If liquid aliphatic amines have been exposed and clothing is contaminated, it must be removed and securely wrapped.

In the event of exposure to aliphatic amines, rinse the eyes with water or neutral saline solution for at least 15 minutes until the pH of the conjunctival fluid is neutral again (pH = 7.0). Other important first aid measures should be continued in the meantime. If rinsing is impeded by eyelid spasm, the use of a local anesthetic solution (e.g. lidocaine, oxybuprocaine) may be considered. Remove any contact lenses, if possible, without additional risk to the eye.

Rinse affected skin and hair areas with water for at least 15 minutes. Continue other important first aid measures during this time. Protect eyes while rinsing skin/hair areas.

4.4. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
Exposure to the eyes can cause serious damage; treat as burns. Consult an ophthalmologist immediately.
Any exposure to aliphatic amines in the facial area and any chemical burn to an area of skin larger than 100cm^2 must be considered serious.
Skin contact with aliphatic amines can cause severe damage; this should also be treated as a burn: adequate fluid administration, analgesic therapy, maintenance of body temperature, covering the affected skin area with a sterile dressing or clean cloth. Pressurized liquid aliphatic amines can cause frostbite.

The following measures are recommended if the concentration of aliphatic amines is 100 ppm or higher and clinical symptoms (e.g. eye irritation or pulmonary symptoms) are present:

- Oxygen administration
- Administration of 8 puffs 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 3 ml NaCl 0.9% 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 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.

If aliphatic amines are swallowed, do not induce vomiting under any circumstances.
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.

4.5. Further procedure 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 performed.

Routine laboratory tests should include complete blood count, glucose and electrolytes.
Radiologically clear signs of pulmonary oedema – enlargement of the hilar regions, typical, centrally accentuated, patchy shadows on the chest X-ray – are late signs that only become apparent 6 to 8 hours or even later after exposure. The X-ray is typically unremarkable on initial presentation at the hospital, even after inhalation of a larger dose.
Patients with a possible exposure concentration of 100ppm or more or with significant clinical complaints or symptoms should be monitored for an appropriate period and undergo repeated follow-up examinations before any consequential damage to health can be ruled out.

Delayed effects are unlikely in patients with only mild, rapidly subsiding upper respiratory symptoms (mild burning or coughing).

If oxygen saturation falls below 90%, arterial blood gas concentrations should be checked immediately and a 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.

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

Clinically asymptomatic patients who were exposed to a concentration of less than 100ppm (depending on the duration of exposure) and 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 verbally and in writing. The patient was advised to seek immediate medical attention if any health complaints arise.
- The patient is aware of and understands the toxic effects of aliphatic amines.
- 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 for at least 72 hours and avoid cigarette smoke; smoke can impair 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. Irritant substances / Corrosive substances. Heidelberg: Jedermann-Verlag, 1992. (Information sheets for hazardous substances; M 004.)

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

German Research Foundation, ed. MAK value justification (mono-)ethylamine, (mono-)methylamine, diethylamine, triethylamine, addendum 1996. MAK value justification for dimethylamine, addendum 1993. Weinheim: Wiley-VCH-Verlag.

Diller WF. Comments on the accident 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: 651-661, 1436.

Goldfrank LR, Flomenbaum NE, Lewin NA, Weisman RS, Howland MA, Hoffman RS. Toxicologic Emergencies. 5th ed. Norwalk: Appleton & Lange, 1994: 376, 754.

Grant WM, Schuman JS. Toxicology of the Eye. 4th ed. Springfield: Charles C Thomas Publisher, 1993: 103-104.

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.

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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