Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Ammonia

CAS No.: 7664-41-7

GHS symbols:

GHS05
Corrosive

GHS06
Acute toxicity

Signal word: Danger

Hazard statements:

H314	Causes severe skin burns and serious eye damage.
H331	Toxic if inhaled.

Overview

- Before paramedics/emergency doctors on site approach a patient, who has been or is exposed to ammonia, they must ensure that there is no danger to themselves from ammonia.
- There is no danger from contact with patients who have only been exposed to ammonia gas. A patient who is wet with ammonia-containing liquid, or whose clothing is contaminated with it, may endanger other people through direct contact or through ammonia gas emissions.
- Ammonia is highly irritating as a gas and in solution 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. Laryngospasm and signs of toxic 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

Ammonia (NH3), CAS 7664-41-7
Ammonia dissolves easily in water to form a caustic alkaline ammonium hydroxide solution. At room temperature, it is a colorless gas with a characteristic pungent odor. Ammonia is lighter than air. When pressurized liquid ammonia is released and rapidly cools, it forms a dense cloud that settles on the ground. Ammonia is widely used as a catalyst and reagent in the manufacture of fertilizers, plastics, explosives, pesticides and other chemicals, as well as a refrigerant. It is a component of many household products and industrial cleaning agents.

2. Exposition

2.1. Inhalation

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

2.2. Skin/eye contact

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

2.3. Ingestion

Accidental ingestion of ammonia is unlikely. If swallowed, ammonia solutions can cause severe damage through chemical burns in the mouth, throat and stomach.

3. Acute health effects

Ammonia gas generally causes irritation to the eyes, nose and throat. Breathing difficulties, including dyspnea with coughing, laryngospasm and bronchospasm, as well as pulmonary oedema, may occur.
If the skin is wet or damp, contact with ammonia gas can cause burning pain, inflammation, blisters and ulcers. Contact with pressurized liquid ammonia may result in frostbite.
Low gas concentrations can cause eye irritation with burning, redness, tearing and involuntary eyelid closure. Higher concentrations or contact with liquid ammonia can cause chemical burns to the cornea, leading to blindness.

3.1. Dose-response relationship

Ammonia concentration		Effect/effects
1 - 20 ppm	-	Odor perception (development of tolerance)
50 ppm	-	Mild irritation of the mucous membranes
300 - 500 ppm	-	Significant irritation of the mucous membranes, eyes and upper respiratory tract with conjunctivitis, feeling of suffocation, coughing increase in blood pressure and heart rate Maximum tolerable concentration over 1 hour
700 ppm	-	Immediate eye damage possible
> 1700 ppm	-	Chest pain, pulmonary oedema, laryngospasm
2500 – 6500 ppm	-	Fatal if exposure lasts longer than 30 minutes
10,000 ppm	-	Fatal within a few minutes

3.2. Possible consequences

After acute exposure, the 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 ammonia can lead to ulceration and even perforation of the cornea, resulting in blindness even weeks or months later. The development of cataracts and glaucoma has been reported.

4. Measures

4.1. Self-protection of first responders

If there is suspicion that the area the helper must enter contains ammonia in an acutely dangerous concentration (500ppm or more), a self-contained breathing apparatus and a chemical protection suit must be worn.
Only for acute rescue measures can short-term exposure to ammonia in concentrations below 500ppm be accepted for rescuers without protective equipment.
There is no danger from contact with patients who have only been exposed to ammonia gas. A patient who is wet with ammonia-containing liquid, or whose clothing is wet with it, may endanger other people through direct contact or through ammonia 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 yourself. 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 ammonia 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 ammonia has been exposed and clothing is contaminated, it must be removed and securely wrapped.
In the event of ammonia exposure, it must be ensured that the eyes have been rinsed with water or neutral saline solution for at least 15 minutes and that the pH value of the conjunctival fluid is neutral again (pH=7.0). Other important first aid measures must be continued during this time. If rinsing is impeded by eyelid spasms, 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 first aid measures during this time. Protect eyes while rinsing.

4.4. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
The following measures are recommended if the ammonia gas concentration is 500ppm 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 adrenaline (epinephrine): Mix 2mg adrenaline (2ml) with 3ml 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.

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 edema (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 coniotomy if necessary.

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

Skin contact with ammonia can cause severe damage; this should be treated as a burn: adequate fluid intake, analgesic therapy, maintenance of body temperature, covering the affected skin area with a sterile dressing. Pressurized liquid ammonia can cause frostbite.
Exposure to the eyes can also cause serious damage; this should also be treated as a burn. Consult an ophthalmologist immediately.

Note: Any contact with liquid ammonia in the facial area can have serious consequences.
Symptomatic patients with an exposure concentration of 500ppm or more should be transported immediately to a hospital with intensive care facilities.

4.5. Further procedure and treatment

In addition to medical history, physical examination and vital signs, pulse oximetry, a p.a. chest X-ray and spirometry should be performed. Routine laboratory tests should include complete blood count, glucose and electrolytes. Radiological signs of pulmonary oedema – enlargement of the hilar regions, typical, centrally accentuated, patchy opacities on 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 500ppm or more 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 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 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 antibiotics are 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

Asymptomatic patients and patients who have been exposed to a concentration of less than 500ppm 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, including instructions on how to proceed, were provided verbally and in writing. The patient was advised to seek immediate medical attention if any health problems arose.
- The attending physician has been informed so that regular contact between the patient and the physician is possible in the following 24 hours.
- Heavy physical work should not be performed in the following 24 hours.
- Do not smoke for at least 72 hours and avoid cigarette smoke; smoke can impair the lung function.

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