

Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Sulfuric acid

CAS No.: 7664-93-9

GHS symbols:



GHS05
Corrosive



GHS06
Acute toxicity

Signal word: Danger

Hazard statements:

H314 Causes severe skin burns and serious eye damage.

Brief information

- A patient who is covered in liquid sulfuric acid or whose clothing is covered in liquid sulfuric acid may endanger other people through direct contact or through sulfuric acid vapors. There is no danger from contact with patients who have only been exposed to sulfuric acid vapors.
- Sulfuric acid has a strong corrosive effect on all tissues. Exposure to the eyes can cause severe burns and subsequent permanent damage to the eye. Skin contact can cause severe burns, which may occur with a delay. Vapors irritate the skin, eyes, nose, throat and respiratory tract, leading to irritation, coughing, chest pain and breathing difficulties. Bronchospasm and 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 on the substance

Sulfuric acid (H₂SO₄), CAS 7664-93-9

Synonyms: vitriol oil, battery acid

At room temperature, sulfuric acid is a clear, colorless, non-flammable oily liquid with a pungent odor when hot. Due to its strong hygroscopic effect, impurities can cause brownish discoloration. Sulfuric acid is widely used in the production of various basic chemicals, fertilizers, explosives, synthetic fibers, paints, medicines, detergents, adhesives and paper. It is used as an electrolyte in car batteries and is used in leather, fur and wool processing, plastics manufacturing, oil and natural gas extraction, uranium processing, metal surface cleaning, food preparation and as a laboratory reagent.

2. Exposition

2.1. Inhalation

Inhalation is a possible route of exposure. The smell of sulfuric acid and its irritating effect on the upper respiratory tract serve as a clear warning of dangerous concentrations.

2.2. Skin/eye contact

Exposure to sulfuric acid occurs mainly through direct contact with the skin and eyes. Skin and eye contact causes severe burns, which may also occur with a delay.

2.3. Ingestion

Ingestion of sulfuric acid causes severe burns to the mucous membranes in the throat and esophagus.

3. Acute health effects

3.1. Dose-response relationship

<u>Sulfuric acid - concentration</u>	<u>Effect/effects</u>
1 mg/m ³	- Odor threshold unbearable
5 mg/m ³	- Coughing
80 mg/m ³	- Danger to life

3.2. Respiratory tract

Sulfuric acid usually causes throat irritation and coughing. This can quickly lead to breathing difficulties with chest pain, shortness of breath, laryngospasm and toxic pulmonary oedema (shortness of breath, cyanosis, sputum, coughing). The symptoms may increase over several hours. Exposure to sulfuric acid can lead to respiratory failure.

3.3. Skin contact

Direct exposure to liquid sulfuric acid causes severe burns to the skin and mucous membranes, which can lead to scarring. Low vapor concentrations or mist can cause pain, redness, inflammation and blistering.

3.4. Eye contact

Exposure to liquid sulfuric acid causes severe burns and subsequent permanent damage to the eye. Low vapor concentrations and mist cause burning, redness, tearing and eyelid closure.

3.5. Possible consequences

If the patient survives the first 48 hours after exposure, further improvement in symptoms can be expected. After acute exposure, lung function usually returns to normal within 7 to 14 days. Complete recovery is

common, but symptoms and lung function limitations may persist. Hyperreactivity in irritants may persist and cause bronchospasm or chronic bronchitis. Destruction of lung tissue or scarring can lead to chronic bronchial dilation and increased susceptibility to infection. Chronic or prolonged exposure to sulfuric acid vapors can lead to pulmonary dysfunction, chronic bronchitis, nasal mucosal ulcers, skin and eye inflammation, and dental damage.

3.6. Carcinogenicity

Exposure to mists of strong inorganic acids containing sulfuric acid is carcinogenic to humans (IARC Group 1, carcinogenic to humans).

4. Measures

4.1. Self-protection of helpers

If there is a suspicion that the area the helper must enter contains sulfuric acid, a self-contained breathing apparatus and a chemical protection suit must be worn. Contaminated equipment should not be used. A patient who is wet with liquid sulfuric acid or whose clothing is wet with liquid sulfuric acid may endanger other people through direct contact or through sulfuric acid vapors. There is no danger from contact with patients who have only been exposed to sulfuric acid vapors.

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" 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)

CRASH decontamination

- Rescue patients who are unconscious or immobile and contaminated with sulfuric acid or oleum (critically ill/injured patients according to the ABCDE scheme) from the immediate danger zone, taking personal precautions and using 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

Patients who have only been exposed to sulfuric acid 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 cleaning. If liquid sulfuric acid has contaminated clothing, it must be removed immediately and securely wrapped.

If the eyes have been exposed to sulfuric acid or if there is eye irritation, they must be rinsed with water or a neutral saline solution for at least 15 minutes. Any contact lenses must be removed, provided this can be done without additional risk 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. Other important first aid measures must be continued during this time. Protect eyes while rinsing.

4.4. Estimation of inhaled dose

Patients with an exposure concentration of 5 mg/m³ or more (depending on the duration of exposure) and patients for whom no exposure dose can be estimated but exposure is very likely should be transported immediately to a hospital with intensive care facilities.

4.5. Initial treatment (preclinical or clinical)

Skin contact with sulfuric acid can cause severe damage; this should be treated as burns: adequate fluid administration, analgesic therapy, maintenance of body temperature, covering the affected skin area with a sterile dressing.

Contact with the eyes can also cause severe damage; this should also be treated as a burn. An ophthalmologist should be consulted immediately.

Note: Any contact with sulfuric acid in the facial area can have serious consequences.

The following measures are recommended if the sulfuric acid concentration is 5mg/m² or more (depending on the duration of exposure), if symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is suspected:

- 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 3 ml NaCl 0.9% and administer via a nebulizer mask
- Administration of a β_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, cricothyotomy.

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

4.6. Further procedure and treatment

Treatment depends on the extent of exposure and the symptoms. There is no known specific antidote. 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 and blood sugar and electrolyte determination.

Radiological 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 still normal at initial presentation at the hospital, even after inhalation of a relevant dose.

Patients with possible exposure should be monitored for an appropriate period and re-examined repeatedly before any consequential damage to health can be ruled out. In cases of mild irritation of the upper respiratory tract that subsides quickly, no long-term effects are usually to be expected.

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.

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

Asymptomatic patients who have been exposed to a concentration of less than 5mg/m² (depending on the duration of exposure), have no complaints and show normal examination findings 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 instructed to seek immediate medical attention if any health complaints arise.
- The patient is aware of and understands the toxic effects of sulfuric acid.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- No heavy physical work for the next 24 hours.
- No smoking and avoid cigarette smoke for at least 72 hours; smoke can impair lung function.
- Spirometry should be repeated at regular intervals after discharge until the values have returned to the patient's baseline values prior to exposure.

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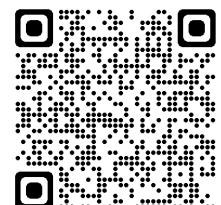
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