BASF Chemical Emergency Medical Guidelines

Sulfuric acid (H_2SO_4) B 1

Information and recommendations for paramedics and doctors at the site

- **Patients whose clothing or skin is contaminated with liquid sulfuric acid can cause secondary contamination of rescue and medical personnel by direct contact. Patients exposed only to sulfuric acid mists do not pose a significant risk of secondary contamination.**
- **Sulfuric acid is rapidly corrosive to all tissues. Eye contact causes severe burns and loss of vision. Contact with the skin cause severe burns, which may be delayed. Mists are irritating to the skin, eyes, and respiratory tract and causing irritation, coughing, chest pain and dyspnea. Laryngospasm and pulmonary edema (shortness of breath, cyanosis, expectoration, cough) may occur.**
- **There is no antidote to be administered to counteract the effects of sulfuric acid. Treatment consists of supportive measures.**

1. Substance information

Sulfuric acid (H_2SO_4), CAS 7664-93-9
Synonyms: oil of vitriol, battery acid.
Sulfuric acid is a clear, colorless nonflammable oily liquid with a choking odor when hot. Its brownish color may be due to organic impurities, which have been charred by the high affinity for water. Sulfuric acid is used as a feedstock in the manufacture of other chemical commodities, synthetic fertilizers, nitrate explosives, artificial fibers, dyes, pharmaceuticals, detergents, glue, paint, and paper. It is an electrolyte in storage batteries. It is used in the leather, fur, food processing, wool, manufacture of plastics, petroleum refining, metal cleaning and pickling, and uranium industries, for gas drying, and as a laboratory reagent.

2. Routes of exposure

Inhalation

Exposures may occur by inhalation of mists. Sulfuric acid's odor and upper respiratory tract irritant properties generally provide adequate warning of hazardous concentrations.

Skin/eye contact

Most exposures occur by direct contact of the skin and the eyes with liquid sulfuric acid. Contact with the skin and the eyes causes severe burns which may be delayed in onset.

Ingestion

Ingestion causes severe corrosive injury of the mucous membranes of the throat and esophagus.

3. Acute health effects

Respiratory

Sulfuric acid exposure usually causes sore throat and coughing. Rapid development of respiratory distress with chest pain, dyspnea, laryngospasm and pulmonary edema (shortness of breath, cyanosis, expectoration, cough) may occur. Lung injury may progress over several hours. Sulfuric acid exposure may cause respiratory failure.

Dermal

Deep burns of the skin and mucous membranes may be caused by contact with liquid sulfuric acid; disfiguring scars may result. Contact with sulfuric acid mists can cause burning pain, redness, inflammation, and blisters.

Ocular

Eye contact causes severe burns and loss of vision. Contact with sulfuric acid mists cause burning discomfort, spasmodic blinking or involuntary closing of the eyelids, redness, and tearing.

Dose-effect relationships — Dose-effect relationships are as follows:

Sulfuric acid concentration		Effect
1 mg/m^3	-	Odor threshold
5 mg/m^3	-	objectionable, producing coughing
80 mg/m^3	-	immediately dangerous to life

4. Actions

Rescuer self-protection

In response situations that involve exposure to potentially unsafe levels of sulfuric acid (see below), pressure-demand, self-contained breathing apparatus and chemical-protective clothing is recommended.
Patients exposed only to sulfuric acid mists do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with liquid sulfuric acid can secondarily contaminate other people by direct contact.

Patient recovery

Patients should be removed from the contaminated zone immediately. If patients can walk, they should walk. Patients who are unable to walk may be removed on backboards or stretchers; if these are not available, carefully carry or drag patients to safety.
Immediate priorities must follow the "**A, B, C's**" (Airway, Breathing, Circulation) of resuscitation.

„CRASH"-Decontamination

a) Rescue with sulfuric acid contaminated, unconscious patients or patients who are unable to move (critically ill/injured patients according to the ABCDE approach) from the danger zone immediately. The use of appropriate personal protective equipment and self- protection have top priority
b) Start Basic Life Support if necessary (e.g. bleeding control with Tourniquet, cardiac massage etc.)
c) In a safe zone: fast and complete removal of clothing using a rescue knife or trauma shears (approx. 1 minute)
d) Short rinsing off with plenty of water (approx. 1 minute)
e) Place patient on a clean rescue sheet. Consider heat preservation. Transport the patient to the handover area to emergency medical services (approx. 1 minute)

Decontamination

Patients exposed only to sulfuric acid mists who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination.
Patients who are able and cooperative may assist with their own decontamination. If the exposure involved liquid sulfuric acid and if clothing is contaminated, remove and double-bag the clothing.
Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 20 minutes, and that the pH of the conjunctival fluid has returned to normal (7.0). If not, continue eye irrigation during other basic care and transport. If eye irrigation is impaired by blepharospasm, one to two drops of oxybuprocaine 0.4 % may be instilled into affected eyes to allow adequate irrigation.
Remove contact lenses, if present and easily removable, without additional trauma to the eye.
Assure that exposed skin and hair have been flushed with plain water for at least 15 minutes. If not, continue flushing during other basic care and transport. Protect eyes during flushing of skin and hair.

Initial treatment

Therapy will be empiric; there is no antidote to be administered to counteract the effects of sulfuric acid.
The following measures are recommended if the exposure concentration is 5 mg/m^3 or greater (depending on time exposed), if symptoms, e. g. eye irritation or pulmonary symptoms have

developed, or if no exposure concentration can be estimated but exposure has possibly occurred:
- **Administration of oxygen**
- **Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.**

Patients with severe clinical respiratory symptoms (e.g. bronchospasms, stridor) should be treated as follows:
a) Nebulization of adrenaline (epinephrine): 2 mg adrenaline (2 ml) with 3 ml NaCl 0.9% and inhale through a nebulizer mask.

b) Administration of a ß2-selective adrenoceptor agonist, e.g., four strokes of terbutaline or salbutamol or fenoterol (one stroke usually contains 0.25 mg of terbutaline sulfate; or 0.1 mg of salbutamol; or 0.2 mg of fenoterol); this may be repeated once after 10 minutes. Alternatively, 2.5 mg salbutamol and 0.5 mg atrovent may be administered by nebulizer mask.
If inhalation is not possible, administration of terbutaline sulfate (0.25 mg to 0.5 mg) subcutaneously or salbutamol (0.2 mg to 0.4 mg over 15 minutes) intravenously.

c) Intravenous administration of 250 mg methylprednisolone (or equivalent steroid dose).

Patients with clinical signs of a toxic lung edema (e.g. foamy sputum, wet crackles) should be treated as follows:
a) Start CPAP-therapy (Continuous Positive Airway Pressure Ventilation).
b) Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose) is recommended.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.

Note: Efficacy of corticosteroid administration has not yet been proven in controlled clinical studies.
If sulfuric acid was in contact with the skin, chemical burns may result; treat as thermal burns: adequate fluid resuscitation and administration of analgesics, maintenance of the body temperature, covering of the burn with a sterile pad or clean sheet.
After eye exposure chemical burns may result; treat as thermal burns. Immediately consult an ophthalmologist.
Note: Any facial exposure to liquid sulfuric acid should be considered as a serious exposure.

Patient release/ follow-up instructions

Patients exposed to a concentration of **less than 5 mg/m^3** (depending on the period of time exposed) **as well as patients who have a normal clinical examination and no signs or symptoms of toxicity may be discharged after an appropriate observation period in the following circumstances:**

a) The evaluating physician is experienced in the evaluation of individuals with sulfuric acid exposure.
b) Information and recommendations for patients with follow-up instructions are provided verbally and in writing. Patients are advised to seek medical care promptly if symptoms develop or recur.
c) The physician is comfortable that the patient understands the health effects of sulfuric acid and the provided follow-up instructions.

d) Site medical is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release.
e) Heavy physical work should be precluded for up to 24 hours.
f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.

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