

Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Formic acid

CAS No.: 64-18-6

GHS symbols:



GHS05
Corrosive



GHS06
Acute toxicity

Signal word: Danger

Hazard statements:

- | | |
|------|--|
| H302 | Harmful if swallowed. |
| H314 | Causes severe skin burns and serious eye damage. |
| H331 | Toxic if inhaled. |

Overview

- A patient who is covered in liquid formic acid or whose clothing is covered in liquid formic acid may endanger other people through direct contact or through formic acid vapors. There is no danger from contact with patients who have only been exposed to formic acid vapors.
- Formic acid is highly corrosive to 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, causing irritation, coughing, chest pain and breathing difficulties. Bronchospasm and 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

Formic acid (HCOOH), CAS 64-18-6

Synonyms: formic acid, methane acid

At room temperature, formic acid is a clear, fuming liquid with a pungent, penetrating odor. Formic acid is used in the manufacture and dyeing of paper and textiles, in leather processing, in electroplating, in glass processing and as an intermediate product in the chemical industry.

2. Exposition

2.1. Inhalation

Inhalation is a possible route of exposure. The odor of formic 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 formic 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 formic acid causes severe burns to the mucous membranes in the throat and esophagus, but this rarely occurs in the workplace.

3. Acute health effects

3.1. Dose-response relationship

<u>Formic acid concentration</u>	<u>Effect/effects</u>
1.6 - 340 ppm	- Odor perception
5 ppm	- Occupational exposure limit (AGS, Germany)
10 ppm	- Occupational exposure limit - short-term value (AGS, Germany)
30 ppm	- IDLH value (NIOSH, USA)
> 50 grams	- Estimated lethal dose if swallowed

Occupational exposure limit: According to the Hazardous Substances Ordinance, the occupational exposure limit (OEL) is the limit value for the time-weighted average concentration of a substance in the air at the workplace in relation to a given reference period. It specifies the concentration of a substance at which acute or chronic harmful effects on health are generally not to be expected.

AGS: Committee for Hazardous Substances

IDLH: Immediately Dangerous to Life and Health

NIOSH: National Institute for Occupational Safety and Health

3.2. Respiratory tract

Formic acid usually causes irritation of the eyes and mucous membranes, throat irritation and coughing. This can quickly lead to breathing difficulties with chest pain, shortness of breath, laryngospasm and pulmonary oedema (shortness of breath, cyanosis, sputum, coughing). The symptoms may increase over several hours. Exposure to formic acid can lead to respiratory failure. The irritant or corrosive effect of liquid or vapors is the main concern; systemic absorption is of secondary importance.

3.3. Skin contact

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

3.4. Eye contact

Exposure to liquid formic acid causes severe burns and subsequent persistent damage to the eye. Low vapor concentrations and mists cause burning, redness, tearing and eyelid closure.

3.5. Ingestion

Ingestion of formic acid causes severe burns to the mucous membranes in the throat and esophagus, but this rarely occurs in the workplace.

3.6. 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 impaired lung function may persist.

Increased sensitivity to irritants may persist and cause bronchospasms or chronic bronchitis. Destruction of lung tissue or scarring can lead to chronic dilation of the bronchi and increased susceptibility to infection. Chronic or prolonged exposure may result in an increased risk of chronic bronchitis.

4. Measures

4.1. Self-protection for first aiders

If there is suspicion that the area the helper must enter contains formic acid, a self-contained breathing apparatus and a chemical protection suit must be worn. Contaminated equipment should not be used. A patient who is covered in liquid formic acid or whose clothing is contaminated with it may endanger other people through direct contact or through formic acid vapors. There is no danger from contact with patients who have only been exposed to formic 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 contaminated with formic acid who are unconscious or unable to move (critically ill/injured patients according to the ABCDE scheme) from the immediate danger zone, taking care to protect yourself with 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 formic 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 formic acid has been exposed and clothing is contaminated, it must be removed immediately and securely wrapped.

In the event of exposure to formic acid, it must be ensured that the eyes are rinsed with water or a neutral saline solution for at least 15 minutes and that the pH value of the tear fluid returns to normal (pH 7). 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 additional risk to the eye.

Rinse affected skin and hair with water for at least 15 minutes. Other important emergency measures must be continued during this time. Protect the eyes during rinsing.

4.4. Estimation of inhaled dose

Patients with an exposure concentration of 10ppm or more (depending on the duration of exposure) and patients for whom no exposure dose can be estimated but who are likely to have been exposed to 10ppm or more should be transported immediately to a hospital with intensive care facilities.

4.5 Initial treatment (preclinical or clinical)

Treatment depends on the extent of exposure and the symptoms. There is no known specific antidote. The following measures are recommended if the formic acid concentration is 10ppm or more (depending on the duration of exposure), symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is assumed:

- 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 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 (0.25 mg to 0.5 mg) 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 coniotomy if necessary.

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

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

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

If formic acid is 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. An endoscopy should be considered to determine the extent of the damage (suspected gastrointestinal necrosis or perforation).

Only if a significant dose was swallowed less than 30 minutes before the patient's endoscopic examination and perforation can be ruled out should immediate gastric lavage be considered.

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

4.6. 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 and blood sugar and electrolyte levels.

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 unremarkable on initial presentation at the hospital, even after inhalation of a larger dose.

Patients with possible exposure should be monitored for an appropriate period and undergo repeated follow-up examinations before any adverse health effects 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 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.

As long as 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

Asymptomatic patients who have been exposed to a formic acid concentration of less than 10 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 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 formic 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.
- Do not smoke and avoid cigarette smoke for at least 72 hours; smoke can impair lung function.
- Patients with severe skin or eye damage 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.

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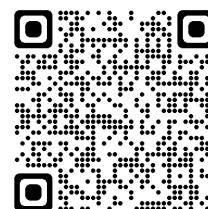
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