

Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Ethylene oxide

CAS No: 75-21-8

GHS symbols:



GHS05
Corrosive



GHS06
Acute toxicity



GHS08
Health hazard

Signal word: Danger

Hazard statements:

H314	Causes severe skin burns and serious eye damage.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H340	May cause genetic defects.
H350	May cause cancer.
H372	Damages organs (nervous system) through prolonged or repeated exposure.
H301+H331	Toxic if swallowed or inhaled.
H360FD	May impair fertility. May damage the unborn child.

Overview

- There is no danger from contact with patients who have only been exposed to ethylene oxide gas.
- However, a patient who is wet with liquid ethylene oxide or solutions containing ethylene oxide, or whose clothing is wet with these substances, may endanger other people through direct contact or through ethylene oxide gas emissions.
- Ethylene oxide can cause impairment of central nervous system functions with convulsions, coma or respiratory paralysis and immediate irritation of the eyes, skin and respiratory tract. Signs of pulmonary oedema (shortness of breath, cyanosis, sputum, cough) may not appear until 12 or more hours after exposure.
- There is no known specific antidote. Treatment depends on the extent of exposure and clinical symptoms.

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1. Information about the substance

Ethylene oxide ([CH₂] 2O), CAS 75-21-8,

Synonyms: epoxyethane, ETO, oxirane

Ethylene oxide is a colorless gas at room temperature and a colorless liquid at temperatures below 11°C. It is extremely reactive and water-soluble. Both the gas and the liquid are flammable and explosive. Ethylene oxide has a sweet, ether-like odor at air concentrations of 500 ppm and above. Nevertheless, ethylene oxide can pose a hazard even at concentrations below the perception threshold. Ethylene oxide reacts with strong acids, alkalis and oxidants.

Ethylene oxide is important in the chemical industry as a solvent, plasticizer and intermediate product. It is used to sterilize medical instruments, food and cosmetics, and to disinfect spices, tobacco, furs and bedding.

2. Exposition

2.1. Inhalation

Exposure to ethylene oxide occurs mainly through inhalation. Even low concentrations that cannot be detected can pose a hazard. Since ethylene oxide is heavier than air, there is a risk of suffocation in poorly ventilated, low-lying or enclosed spaces.

2.2. Skin/eye contact

Gaseous and liquid ethylene oxide can also be absorbed through the skin and eyes. Direct contact with the gas or a concentrated solution can cause severe skin/eye irritation.

2.3. Ingestion

Ingestion of ethylene oxide is unlikely as it is in a gaseous state at room temperature.

3. Acute health effects

Respiratory tract:

A concentration of 200 ppm quickly causes irritation of the nasopharynx. Higher concentrations can cause tracheitis, bronchitis, bronchoconstriction and atelectasis. Acute pulmonary oedema can occur 12 hours or more after exposure.

Skin contact:

Skin contact with gaseous or liquid ethylene oxide can cause skin irritation with redness, blistering, pus formation and scabbing. Skin reactions may occasionally occur 12 or more hours after exposure. Contact with pressurized liquid ethylene oxide can cause frostbite. Inhalation and skin contact can cause sensitization or allergic reactions, resulting in contact dermatitis, urticaria or anaphylactic reactions.

Eye contact:

High gas concentrations or splashes of concentrated solutions can cause eye irritation and inflammation as well as corneal damage.

Nervous system:

Ethylene oxide has central nervous system depressant effects. Exposure to high concentrations can manifest in various neurological disorders such as seizures or coma. Signs and symptoms may occasionally appear more than 12 hours after exposure. Respiratory paralysis and delayed peripheral neuropathies have been reported after massive exposure.

Gastrointestinal tract:

Even exposure to low gas concentrations can lead to nausea and vomiting, often with a delay.

Cardiovascular system:

Arrhythmias may occur after inhalation of high gas concentrations.

4. Measures

4.1. Self-protection of the first aiders

Areas where exposure to gaseous ethylene oxide is possible may only be entered with self-contained breathing apparatus and chemical protection suits. There is no danger from direct contact with patients who have only been exposed to ethylene oxide gas.

Patients who are themselves or whose clothing is wet with liquid ethylene oxide (ambient temperature below 11°C) or solvents containing ethylene oxide may endanger other persons through direct contact or through ethylene oxide outgassing.

4.2. Rescue

Patients should be rescued from the danger zone immediately. If they are unable to leave the danger zone on their own, they should be evacuated from the area quickly using appropriate means, taking care to protect themselves. The "A, B, C procedure" has absolute priority in treatment.

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 ethylene oxide gas and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others.

If liquid ethylene oxide or solvents containing ethylene oxide have contaminated clothing, remove the clothing, pack it securely and dispose of it. Ensure that affected areas of skin and hair are rinsed with water for at least 15 minutes. If possible, patients should assist in cleaning themselves.

Unaffected eyes must be protected during rinsing. If the eyes are affected, ensure that they are rinsed with water or sodium chloride solution (0.9%) for at least 15 minutes in the event of ethylene oxide exposure. Contact lenses should be removed, if possible, without causing additional danger to the eyes.

Life-saving measures should be continued as best as possible during decontamination, while ensuring personal protection.

4.4. Initial treatment (preclinical or clinical)

Symptomatic therapy; no specific antidote available.

The following measures are recommended if respiratory complaints or symptoms or systemic toxic effects occur after inhalation of ethylene oxide:

- 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 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, coniotomy.

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

Direct contact with liquid ethylene oxide can cause severe skin damage. This should be treated as burns: adequate fluid administration, analgesic therapy, maintenance of body temperature, covering the affected skin area with sterile dressings.

Severe damage can also occur after exposure to the eyes. This should also be treated as burns and patients should be referred to an ophthalmologist as soon as possible.

4.5. Further procedure and treatment

In addition to taking a medical history, performing a physical examination and checking vital signs, the patient should be monitored using pulse oximetry and a chest X-ray and spirometry should be performed.

Routine laboratory tests should include a complete blood count, liver and kidney function parameters, glucose and electrolytes. Since neurological symptoms or respiratory problems may only occur after a delay following exposure, patients should be monitored for an adequate period and examined repeatedly. Hospitalization should be considered for patients with signs of systemic toxic effects, regardless of the route of exposure.

The X-ray is typically normal at the initial presentation at the hospital, even after inhalation of a larger dose. Radiological signs of pulmonary edema may only appear several hours after exposure.

If oxygen saturation continues to fall, arterial blood gas concentrations should be determined immediately and a follow-up chest X-ray performed.

If there are signs of pulmonary oedema, oxygen should be administered via a mask. If the condition worsens, ventilation therapy with positive end-expiratory pressure (PEEP) or CPAP therapy should be considered within the first 24 hours after exposure. An early indication for PEEP therapy or CPAP therapy is, for example, tachypnoea (>30/min) with a simultaneous decrease in carbon dioxide partial pressure. An insufficient increase or a relative decrease in oxygen partial pressure despite hyperventilation indicates the development of pulmonary oedema.

Fluid intake and excretion as well as electrolytes should be closely monitored. A positive balance should be avoided. Invasive volume monitoring should be considered to optimize fluid management.

If signs of pulmonary oedema are present, intravenous administration of 1g methylprednisolone (or an equivalent steroid dose) can be repeated every 12 hours.

Pneumonia can occur as a complication of severe pulmonary edema. Prophylactic antibiotic administration is not routinely recommended but may be considered based on the results of sputum cultures.

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

Clinically asymptomatic patients who show unremarkable clinical examination 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 have been provided verbally and in writing.
- The patient was informed in detail about the possible effects and symptoms following ethylene oxide exposure and understood this information.
- Avoid physical exertion for the next 48 hours and do not smoke. 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 epichlorohydrin.
- 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 eye exposure 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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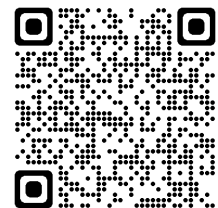
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