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## Information and recommendations for paramedics and doctors at the site

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- Before approaching the patient, the paramedics must make sure that they do not risk exposing themselves to hydrogen chloride.
  - Patients exposed only to hydrogen chloride gas (boiling point  $-85^{\circ}\text{C}$ ,  $-121^{\circ}\text{F}$ , respectively) do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with hydrochloric acid can cause secondary contamination of rescue and medical personnel by direct contact or through off-gassing hydrogen chloride.
  - Hydrogen chloride gas is rapidly corrosive when it comes in contact with moist tissue such as the eyes, skin, and upper respiratory tract causing eye 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 hydrogen chloride. Treatment consists of supportive measures.
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### 1. Substance information

Hydrogen chloride (HCl), CAS 7647-01-0

Synonyms: anhydrous hydrochloric acid, hydrochloric acid gas

At room temperature hydrogen chloride is a colorless gas with a sharp or pungent odor. Under pressure or at temperatures below  $-85^{\circ}\text{C}$  ( $-121^{\circ}\text{F}$ ), it is a clear liquid. On exposure to air dense white vapor is formed, due to condensation with atmospheric moisture. In contact with moisture, it forms hydrochloric acid. The vapor formed is corrosive.

Hydrogen chloride is available as anhydrous gas or aqueous solution (hydrochloric acid). Aqueous solutions are usually colorless but may be yellow due to trace impurities. Hydrogen chloride is widely used in chemical processes and production.

### 2. Routes of exposure

#### *Inhalation*

**Most exposures occur by inhalation.** Hydrogen chloride's odor and upper respiratory irritant properties generally provide adequate warning of hazardous concentrations. Hydrogen chloride is heavier than air and may cause asphyxiation in poorly ventilated, low-lying, or enclosed spaces.

#### *Skin/eye contact*

Direct contact with liquid hydrogen chloride or concentrated gas on wet or moist skin causes severe chemical burns. It is poorly absorbed through the skin.

#### *Ingestion*

Ingestion of hydrogen chloride is unlikely because it is a gas at room temperature. Aqueous solutions (hydrochloric acid) cause severe corrosive injury if ingested.

### 3. Acute health effects

#### *Respiratory*

**Hydrogen chloride 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. Pulmonary injury may progress over several hours. Hydrogen chloride poisoning may cause respiratory failure.

#### *Dermal*

Deep burns of the skin and mucous membranes may be caused by contact with concentrated hydrochloric acid; disfiguring scars may result. Contact with less concentrated hydrogen chloride gas or hydrochloric acid mist can cause burning pain, redness, inflammation, and blisters.

Contact with liquid hydrogen chloride under pressure can result in frostbite.

*Ocular*

Low gas concentrations cause burning discomfort, spasmodic blinking or involuntary closing of the eyelids, redness, and tearing. Corneal burns, cataracts and glaucoma may occur from exposure to high concentrations.

*Dose-effect relationships*

Dose-effect relationships are as follows:

<u>Hydrogen chloride concentration</u>	<u>Effect</u>
0.067-0.134 ppm	- No change in respiratory pattern
5 ppm	- No organic damage
10 ppm	- Irritation; work undisturbed
10-50 ppm	- Work difficult; throat irritation after short exposure
50-100 ppm	- Intolerable; work impossible
1000-2000 ppm	- Brief exposures dangerous; laryngospasms; lethal after a few minutes

The concentration that should not be exceeded during any part of the working exposure is 5 ppm.

**4. Actions**

*Rescuer self-protection*

**In response situations that involve exposure to potentially unsafe levels of hydrogen chloride (see below), pressure-demand, self-contained breathing apparatus and chemical-protective clothing is recommended.**

Patients exposed only to hydrogen chloride gas do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with liquid hydrogen chloride can secondarily contaminate other people by direct contact or through off-gassing hydrogen chloride.

*Patient recovery*

Patients should be removed from the contaminated zone immediately. Patients who are unable to walk may be removed on backboards or stretchers; if these are not available, carefully remove/transport patients with appropriate action to a safe zone, taking into account your self-protection.

Immediate priorities must follow the "A, B, C's" (Airway, Breathing, Circulation) of resuscitation.

*„CRASH“-Decontamination*

- a) Rescue with hydrogen chloride 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 hydrogen chloride gas 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 hydrogen chloride 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 hydrogen chloride.

**The following measures are recommended if the exposure concentration is 10 ppm 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  $\beta$ 2-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.

**Patients exposed to a concentration of 10 ppm or greater (depending on time exposed) and patients without available exposure measurements but suspected of being exposed to concentrations of 10 ppm or greater (depending on time exposed) should be transferred to a hospital/emergency department.**

If hydrogen chloride 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 hydrogen chloride should be considered as a serious exposure.

*Patient release/  
follow-up instructions*

Patients exposed to a concentration of **less than 10 ppm** (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 hydrogen chloride 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 hydrogen chloride 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 24 hours.
- f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.

In this document BASF has made a diligent effort to ensure the accuracy and currency of the information presented but makes no claim that the document comprehensively addresses all possible situations related to this topic. This document is intended as an additional resource for paramedics and doctors at the site in assessing the condition and managing the treatment of patients exposed to hydrogen chloride. It is not, however, a substitute for the professional judgement of a paramedic or a doctor and must be interpreted in the light of specific information regarding the patient available to such a paramedic or doctor and in conjunction with other sources of authority.

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