
Information and recommendations for first responders

- Patients whose clothing or skin is contaminated with hydrofluoric acid can secondarily contaminate rescue and medical personnel, by direct contact or through evaporation of hydrofluoric acid.
 - Hydrofluoric acid is a highly corrosive chemical causing extremely painful burns.
 - Fluoride ions are very well and rapidly absorbed by all exposure routes. Thus, hydrofluoric acid can also cause systemic poisoning resulting in central nervous system disturbances, cardiovascular, renal, and respiratory failure.
 - Rapid decontamination by immediate extensive irrigation - even before removing clothing - with copious amount of water is the most critical measure after dermal exposure.
 - The early administration of calcium and/or magnesium can counteract the systemic effects of hydrofluoric acid.
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1. Substance information

Hydrogen fluoride (HF), liquid or gas (CAS 7664-39-3), is clear and colorless with a strong and irritating odor.

The boiling point of hydrogen fluoride is 19-20°C, 292-293 K. Hydrogen fluoride is miscible in water and forms a clear and colorless aqueous solution, hydrofluoric acid (boiling point of the azeotrope 112°C, 385 K). Some substances hydrolyze to form hydrogen fluoride (cobalt trifluoride, phosphorus pentafluoride, silicon tetrafluoride, sulfur tetrafluoride).

When exposed to air, hydrogen fluoride and its solutions may produce pungent dangerous fumes. Significant vapor concentrations may occur when concentrations of hydrofluoric acid of >40% in water are heated.

The substance is a strong acid and reacts violently with many compounds causing fire and explosion hazard. It attacks metals, glass and stone and dissolves silica, and must be kept in plastic, lead, wax, or paraffin paper bottles. Hydrofluoric acid is used in solutions of various concentrations (concentrated - >50%, e.g. in industrial processes; intermediate - 20-50%, e.g. in the electronics industry; dilute - less than 20%, e.g. in industrial and consumer cleaning compounds). Typical uses are frosting, etching and polishing of glass, removing sand from metal castings, enameling and galvanizing iron, and etching silicon wafers, especially in the semiconductor industry.

2. Routes of exposure

Inhalation

Significant absorption of fluoride ions leading to systemic toxicity may occur by inhalation of hydrofluoric acid fumes or vapors.

Hydrofluoric acid's strong irritant properties usually provide an adequate warning of acutely hazardous concentrations.

Skin/eye contact

Skin contact is the major route of toxic hydrofluoric acid exposures. Fluoride ions are absorbed very well and rapidly through the skin and eyes and cause systemic toxicity. If more than 160 square cm (25 square inches) of skin are affected, there is risk of serious systemic toxicity. Even dilute solutions (<2%) may cause severe eye or skin burns if contact is prolonged.

Ingestion

Accidental ingestion of hydrofluoric acid may occur and rapidly lead to severe systemic toxicity. Deaths in adults have been described after ingestion of 1.5 g or more.

3. Acute health effects

At all sites of oral, gastroesophageal, dermal, or ocular contact hydrofluoric acid can cause severe painful burns.

After skin exposure redness, swelling, blistering as well as white discoloration of the skin can occur.

Inhalation usually causes sore throat and coughing. Rapid development of respiratory distress with chest pain, dyspnea, swelling of the throat and accumulation of fluid in the lungs may occur. **Pulmonary injury may progress over several hours.**

Reaction of fluoride with body calcium may occur by any route of exposure to hydrofluoric acid. This can cause a marked lowering of serum calcium (hypocalcemia) and other metabolic changes which may result in a fatal outcome. In particular, arrhythmia of the heart leading to cardiovascular failure as well as renal failure may occur. Fluoride ions may also have a direct toxic effect on the central nervous system leading to coma and respiratory failure.

4. Actions

Rescuer self-protection

If the zone which has to be entered by the rescuer is suspected of containing hydrofluoric acid in response situations that involve exposure to hydrofluoric acid vapor or fumes or contact with liquid hydrofluoric acid, pressure-demand, self-contained breathing apparatus and chemical-protective clothing shall be worn; do not use equipment that is contaminated itself.

Patients whose clothing or skin is contaminated with hydrofluoric acid may secondarily contaminate rescue and medical personnel, by direct contact or through evaporation of hydrofluoric acid. Exposure to high concentrations of hydrofluoric acid vapor or fumes may cause absorption of hydrofluoric acid onto clothing; caution should be exercised in decontamination.

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" of resuscitation:

- A) Airway** (make sure the airway is not blocked by the tongue or a foreign body)
- B) Breathing** (check to see if the patient is breathing, provide ventilation with use of appropriate barrier devices, e.g. with a pocket face mask, if breathing is absent)
- C) Circulation** (start CPR in any unresponsive person with absent or abnormal breathing)

Decontamination

All patients exposed to hydrofluoric acid require immediate decontamination. Patients who are able and cooperative may assist with their own decontamination.

Irrigate exposed or irritated eyes with plain water or saline until medical care is available. Remove contact lenses if present and easily removable without additional trauma to the eye. Continue other basic care during flushing.

Flush exposed skin and hair immediately - even before removing clothing - for at least 5 minutes with copious amounts of plain water until calcium gluconate 2.5% gel is available. If the exposure involved liquid hydrofluoric acid and if clothing is contaminated, remove and double-bag the clothing. **Protect eyes during flushing of skin and hair. Wearing protective (e.g. surgical) gloves, start massaging the calcium gluconate gel into the burn site. Apply new gel every 15 minutes** flushing the skin in between with water until medical care is available.

Note: If calcium gluconate gel is not available, iced benzalkonium chloride 0.13% soaks or compresses can be used as an alternative.

In case of hydrofluoric acid ingestion, **do not induce emesis. The vomitus may contain hydrofluoric acid and result in secondary contamination. Patients who are conscious and able to swallow should be given immediately 1-2 glasses of milk and/or 12 antacid (magnesium hydroxide, calcium carbonate) tablets/suspensions.**

Further actions

While decontamination proceeds, each potentially exposed person should seek immediate medical advice and treatment.

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 first responders in assessing the condition and managing the treatment of patients exposed to hydrofluoric acid. It is not, however, a substitute for the judgement of a first responder and must be interpreted in the light of specific information regarding the patient available to such a first responder and in conjunction with other sources of authority.

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