

Hydrogen Fluoride Protocol

Introduction

Hydrogen Fluoride (Hydrofluoric Acid, HF) is a very toxic and corrosive acid. Anhydrous hydrogen fluoride is a gas at room temperature and one atmosphere pressure. Solutions of hydrofluoric acid are clear, colourless liquids. Regardless of its physical state or concentration of solution HF has an irritating pungent odour.

Hydrofluoric acid differs from other acids because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers. In the body, hydrofluoric acid reacts with the ubiquitous ions calcium and magnesium and so can disable the many tissues and organs whose proper function depends on these metal ions.

Exposure to hydrofluoric acid may not be initially painful, and symptoms may not occur until several hours later, when the acid begins to react with calcium in the bones. Under most circumstances without treatment, hydrofluoric acid exposure results in severe or even lethal damage to the heart, liver, kidneys, and nerves. In all cases, hydrofluoric acid exposure requires immediate professional medical attention.

Health Effects

Skin Contact

HF coming into contact with the skin and eyes can cause serious burns. Symptoms of skin exposure to dilute HF are not felt immediately, but deep burns can occur, leading in some cases to permanent loss of tissue. For example a person exposed to 5% HF for a number of hours through a pinhole in a glove lost a phalanx of their finger.

Significant skin exposure to highly concentrated solutions may lead to extremely low blood calcium levels (acute hypocalcaemia), followed by heart attack and death. Burns larger than 25 square inches (160 square cm) may result in serious systemic toxicity. Solutions of less than 20% HF can produce pain and redness with delay up to 24 hours after skin exposure. 20 to 50% HF produces pain and redness within 8 hours, and solutions of more than 50% produce immediate burning, redness and blister formation.

Eye Contact

HF can cause severe eye burns with destruction or opacification of the cornea. Blindness may result from severe or untreated exposures.

Inhalation

Inhalation of a high concentration of HF can result in burns of the mucous membranes and may cause obstruction of the airway and acute pulmonary edema. Acute symptoms may include coughing, choking, chest tightness, chills, fever and cyanosis (bluish tone to the skin due to low blood oxygen levels).

Ingestion

Ingestion of HF may result in severe burns to the mouth, esophagus and stomach. Severe systemic effects such as hypocalcaemia usually also occur.

Safety Precautions

Handling

1. All employees and students who are expected to work with HF must be properly trained in its hazards, safe use and handling.
2. Prior to handling HF, employees and students must read and understand the Material Safety Data Sheet (MSDS).
3. No employee or student handling HF shall work alone.
4. HF must be handled only in a properly functioning fume hood.
5. HF must be used in the smallest possible amounts.
6. Functional safety showers and an eye wash stations must be readily available in the immediate work areas.
7. Containers containing HF must be inspected prior to handling.
8. Containers containing HF must be tightly closed when not in use. Open containers must not be left unattended.
9. Compatible corrosion-resistant equipment is to be used when dispensing HF.
10. HF should be dispensed into sturdy containers made of compatible materials (see Storage section)
11. Empty containers must be treated with caution as they contain hazardous residues.
12. The following personal protective equipment must be used when handling HF:
 - a) Goggles (synthetic, not glass)
 - b) Face Shield
 - c) Neoprene, nitrile or polyvinyl chloride (PVC) Gloves (double glove as necessary)
 - d) Acid Resistant Apron
 - e) Shoe Covers
13. Care should be taken to prevent skin contact with gloves that were used for handling HF, even when contamination of the gloves is not suspected.
14. All employees and students working with HF should wash their hands after working with HF.

Storage

1. HF must be stored in a cool, dry place away from incompatible materials. HF reacts with many materials including concrete, glass, metals, water, other acids, oxidizers, reducers, alkalis, combustibles and organics.
2. HF should be stored in containers made of polyethylene, fluorocarbon plastic or carbon steel. HF must not be stored in glass containers.
3. HF containers must be properly labeled. All labels must meet the Workplace Hazardous Materials Information System requirements.
4. The storage area should be clearly identified, be clear of obstruction and be accessible only to trained personnel.
5. Secondary protective containers must be used when this material is being stored or transported. The secondary container must fully enclose the primary one, and must also be made of polyethylene, fluorocarbon plastic or carbon steel. Many household plastic storage containers can be used in this role.

Spills

1. Laboratories where HF is used must be equipped with a proper spill kit. The dedicated spill kit for HF can be purchased from a lab safety supplier.
2. In case of a small spill:
 - a. Evacuate the area
 - b. Eliminate all sources of ignition
 - c. Put on proper protective clothing
 - d. Use the spill kit to clean up the spill (follow the instructions that come with the spill kit)
3. In case of a large spill:
 - a. Evacuate the area
 - b. Eliminate all sources of ignition if possible
 - c. Call Environmental Protection Services at 416-978-7000 (Weekdays 8:00 to 4:00). Advise them that HF has been spilled. After hours call Campus Emergency Call Centre at the following numbers.

St. George Police	416-978-2222
UTSC Police	416-287-7333
UTM Police	905-569-4333

Disposal

1. Used HF must be disposed of in accordance with the Laboratory Hazardous Waste Management and Disposal Manual. The manual can be found online at the EHS website - www.ehs.utoronto.ca

First Aid Supplies

1. Areas where HF is used must be equipped with the following first aid supplies:
 - a) 2.5% calcium gluconate gel
 - b) Neoprene, PVC or 8 mil thick nitrile gloves
 - c) Mouth guards or shields for artificial respiration
 - d) Milk of magnesia, Mylanta, Maalox, Tums, Caltrate or other antacid tablets
2. Every area where HF is used must be equipped with the “HF Medical Treatment Package”. The package must be readily available to all workers and must contain the following:
 - a) The letter from the Director of the Schwartz-Reisman Emergency Centre – Mount Sinai Hospital, which can be found at the end of this protocol as well as on the EHS website under “Policies and Procedures”.
 - b) The letter to the triage nurse and the attending physician, which is also appended to this document and is posted on the EHS webpage.
 - c) The “HF First Aid Report Form”, which is to be filled out at the hospital, and which also appears on the website.
 - d) Nitrile gloves.
3. All individuals working in the area where HF is used must be familiar with the location of the first aid supplies.

First Aid Treatment

Skin Contact

1. Immediately proceed to a safety shower and flood the affected body area thoroughly with large amounts of water.
2. Remove all contaminated clothing, footwear and jewelry while rinsing. Calcium gluconate gel can be massaged into skin while flushing with water. PVC, nitrile or neoprene gloves must be worn while touching the victim.
3. While the victim is being rinsed with water, call 9-911 and 8-2222 (St. George campus) from a University phone. Indicate that a person was exposed to hydrofluoric acid.
4. Apply calcium gluconate gel every 15 minutes and massage continuously.
5. Continue applying calcium gluconate gel while transporting the victim to the emergency room at Mount Sinai Hospital. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.

6. Inform responders and all others that the exposure involved hydrofluoric acid. Provide the medical personnel with the “HF Medical Treatment Package”.

Eye Contact

1. Immediately proceed to an eye wash station and flush eyes with water for at least 15 minutes. Hold the eyelids open and away from the eye during irrigation. If the person is wearing contact lenses, the lenses should be removed, if possible.
2. Do not apply calcium gluconate gel to eyes.
3. Take the victim to the Mount Sinai emergency room. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.
4. Ice water compresses may be applied to the eyes while transporting the victim to the emergency room at the Mount Sinai Hospital.
5. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the “HF Medical Treatment Package”.

Inhalation

1. Remove victim from the exposure.
2. If the victim is not breathing, begin artificial respiration immediately. Avoid mouth to mouth contact by using mouth guards or shields.
3. Call 9-911 or 8-2222 (St. George campus) from a University phone. Indicate that a person was exposed to hydrofluoric acid.
4. Oxygen should be administered as soon as possible by a trained individual.
5. Arrange transportation of the victim to Mount Sinai Hospital. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.
6. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the “HF Medical Treatment Package”.

Ingestion

1. Call 9-911 and 8-2222 from a University phone. Indicate that a person has ingested hydrofluoric acid.
2. Have the victim drink large amounts of water as quickly as possible to dilute the acid. Do not induce vomiting.

3. Give victim several glasses of milk or about 100 ml of milk of magnesia, Mylanta, Maalox, etc, or grind up and administer up to 30 Tums, Caltrate or other antacid tablets with water.
4. Arrange transportation of the victim to Mount Sinai Hospital.
5. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the “HF Medical Treatment Package”.

Medical Treatment

The summary of medical treatment information is contained in the “HF Medical Treatment Package”. The Medical Treatment Package must be taken along when transporting the victim to Mount Sinai Hospital and provided to the medical personnel.

Designated Medical Facility:

Emergency Department
Mount Sinai Hospital
600 University Avenue
Toronto, Ontario
M5G 1X5

HF First Aid Report Form

This form is to be taken with the victim to the emergency room.

Employee Information:

Last Name: _____ First Name: _____

Employing Department: _____

Building/Room (Location): _____

Supervisor's Name: _____

Contact Phone Number: _____

Exposure Information:

Date of Incident: _____ Time of Incident: _____

Type of Exposure: Skin
 Eye
 Ingestion
 Inhalation

Injury Description: _____

First Aid Information:

Person Administering First Aid: _____

Contact phone Number: _____

Time of Treatment: _____

First Aid Measures taken: _____



Schwartz/Reisman Emergency Centre

Emergency Associates

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Staff Physicians:

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Dr. Harold Fisher
Dr. John Foote
Dr. Raj Grewal
Dr. Brian Goldman
Dr. Shauna Martiniuk
Dr. Yasmine Mawji
Dr. Evan McIntosh
Dr. Don Melady
Dr. Richard Nahas
Dr. Tomas Novak
Dr. Sev Perelman
Dr. Jeff Singh
Dr. Heather Sues-McKay
Dr. Michael Wansbrough

Dear Triage Nurse;

This patient has had an exposure to HF - hydroflouric acid. This is a life and limb threatening emergency in which time is of the essence. Please triage as a Level 2 case and have the ER physician see the patient immediately. There is a step by step protocol available on our intranet page under "Patient Care Guidelines and Protocols" which will describe the treatment necessary. If you have questions you can always page me or call the U of T occupational health physician, Dr. Gabor Lantos, at pager (416) 245-5544; after the prompt; 94213

Sincerely,

Howard Ovens, MD, CCFP(EM), FCFP
Director, Schwartz/Reisman Emergency Centre
Assoc. Professor, Dept. of Family & Community Medicine
University of Toronto

HO:sj

Letter for Triage Nurse/Attending Physician (2 pages)

Hydrofluoric Acid Caution!

To Triage Nurse

This person was exposed to Hydrofluoric Acid!

Do not treat as a simple chemical burn!
The patient should be treated as
CTAS 2.

See enclosed note from Dr. H. Ovens.

To Treating Nurse/Physician

Protect yourself and your staff!
Do not touch the victim with your bare hands!
Do not use regular gloves!
Wear gloves enclosed in this envelope.
See inside the envelope for treatment reference.
Refer to Mt. Sinai Hospital ER protocol

HYDROFLUORIC ACID (HF) - General Info

- HF is a very toxic and corrosive acid
- HF quickly penetrates tissues resulting in burns that require specialized treatment
- Cardiac symptoms can be delayed up to 24 hours after skin exposures
- Exposure of less than 10% of the body to HF can be fatal
- In high concentration can lead to systemic toxicity
- Can cause hypocalcemia, cardiac arrhythmias, metabolic imbalances, pulmonary edema
- Patient requires ECG and cardiac monitor

Caution: Wear nitrile gloves when touching the patient or removing their clothing!

Medical Treatment Summary

Skin Burns		Eye Exposure	Inhalation		Ingestion
Concentrated HF	Dilute HF	All HF	Concentrated HF	Dilute HF	All HF
<ul style="list-style-type: none"> • Debride (if necessary) • Calcium Gluconate 2.5% Gel • Calcium Gluconate 5% Injection locally • Observe for/treat Systemic Effects (especially if > 25 sq. in.) • Monitor for development of hypocalcemia 	<ul style="list-style-type: none"> • Debride (if necessary) • Calcium Gluconate 2.5% Gel • Calcium Gluconate 5% Injection (if necessary) 	<ul style="list-style-type: none"> • Water Wash or Saline Wash • Topical Tetracaine Hydrochloride • 1% Calcium Gluconate Irrigation 	<ul style="list-style-type: none"> • Oxygen and 2.5% Calcium Gluconate by Nebulizer • Observe • Prophylactic Inhalation Steroids • Treat (if necessary) Bronchoconstriction, Pulmonary Edema, Systemic Effect 	<ul style="list-style-type: none"> • Oxygen and 2.5% Calcium Gluconate by Nebulizer (if necessary) • Observe 	<ul style="list-style-type: none"> • Lavage with Calcium Gluconate • Treat Systemic Effects

Adapted from Honeywell Document "Recommended Medical Treatment for Hydrofluoric Acid Exposure"