

Appendix 1

McMaster University Hydrogen Fluoride Emergency Protocol

Contents:

1.0 Hydrogen Fluoride

2.0 Routes of Exposure

3.0 First Aid Measures

3.1 Skin Burns

3.2 Eye Burns

3.3 Inhalation

3.4 Oral Ingestion

3.5 Nail Burns

4.0 Supplies

5.0 Training

5.1 Persons working with HF/Fluorine compounds

5.2 Managers

5.3 Emergency Response Personnel

5.4 Hamilton Health Sciences Emergency Medicine

6.0 Reporting and Follow Up

7.0 Information for presentation at emergency medicine services

8.0 References

Appendices

First Aid Supplies

Material Safety Data Sheets for Hydrogen Fluoride (HF)

HF First Aid Summary Report

McMaster University Injury and Incident Report

Medical Facilities

Emergency Treatment Sign for Transport with Injured Person

Hydrogen Fluoride Emergency Protocol

1.0 Hydrogen Fluoride (HF)

Most fluorides produce HF when coming into contact with moisture and produce similar burns and health effects. This protocol applies to fluoride compounds as well as both anhydrous and aqueous HF.

Both liquid and vapour can cause severe burns, which may not be immediately painful or visible. HF will penetrate the skin and attack underlying tissues.

Systemic toxin that may result in severe hypocalcemia, hypomagnesemia, hyperkalemia, metabolic acidosis, cardiac dysrhythmias and death. HF may produce severe ocular and dermal injury as well as acute life threatening systemic toxicity with minimal external tissue damage.

2.0 Routes of Exposure

Ingestion, inhalation, dermal and eye exposure

3.0 First Aid Measures

At all times, persons touching the injured person must wear protective rubber gloves.

3.1 Skin Burns:

3.1.1 Immediate measures:

1. **Immediately** flush area with copious amounts of **cold** water by either at tap or safety shower. **Quickly and thoroughly** wash the acid off the affected areas.
2. Remove all clothing coming into contact with the acid.
3. Continue under water until calcium gluconate gel is available for application.
4. Calcium gluconate can be massaged into skin while flushing with water.
5. Contact emergency medical personnel and continue with first aid measures.
6. Apply calcium gluconate 2.5% gel every 15 minutes and massage continuously until the pain disappears. If pain recurs, apply calcium gluconate gel and massage while transporting the injured worker to the nearest emergency room.
7. Using 23% aqueous calcium gluconate, massage into the affected area(s). Apply cold compresses of the same solution, changing frequently and when the compresses are losing their wetness.
8. Continue while transporting to a medical facility.

3.1.2 For deep burns:

Administration of the following procedure should be performed by a physician only.

1. Infiltration of aqueous calcium gluconate 5% solution with a small-gauge needle around the affected area and intralesionally may be necessary. Initially use no more than 0.5cc per square centimeter of burned skin. Do not distort skin appearance.
2. Caution must be observed to avoid calcium overdosing. Do not use local anaesthetics. Resolution of pain is the means to determine effective medical treatment.
3. In some cases, it may be necessary to surgically remove damaged tissue and then apply calcium gluconate (5% aqueous solution) to the affected area.
4. Persons with HF burns covering >8 square inches should be admitted immediately to an intensive care unit and monitored carefully for 24 to 48 hours. Serum calcium, potassium and magnesium levels should be monitored. The Q-T interval should be followed for signs of hypocalcemia. Hypocalcemia results in prolonged QT intervals. Systemic hypocalcemia can be immediately life threatening. Large surface area burns may require massive intravenous calcium infusions. Awaiting a serum calcium level may be too late. Following the Q-T interval is the better clinical adjunct.

3.2 Eye Burns:

1. Flush immediately with water for at least 15 minutes while holding eyelids open.
2. Do not use oils, salves, ointments or other HF skin burn treatments.
3. Sterile saline solution is available, flushing may be limited to 5 minutes. Place a Morgan's lens or the Eye irrigator on patient and irrigate the eye intermittently for 20 minutes with an aqueous calcium gluconate 1% solution.
4. Transport patient to emergency for further treatment.
5. Instill aqueous calcium gluconate 1% solution every 2 to 4 hours for the next 2 to 3 days.

3.3 Inhalation:

1. Remove victim from source of HF fumes.
2. If not breathing, begin artificial respiration immediately.
 - a. Mouth to mouth resuscitation is not recommended.
3. Give 100% oxygen by mask.

Further emergency care should be performed by a physician only or licensed emergency medical personnel.

4. As soon as possible, emergency first aid provider will give 2.5 to 3% calcium gluconate solution by inhalation by Intermittent Positive Pressure Breathing using a nebulizer or by nebulizer alone.
5. Patient should be referred to a pulmonologist for further care.
6. Carefully watch the patient for edema of the upper airway with respiratory obstruction. The airway may be maintained by either endotracheal intubation or tracheotomy if necessary.
7. Pulmonary edema should be treated by placing the patient on IPPB with Positive End-Expiratory Pressure (PEEP). Close supervision and continued use of 2.5% to 3% calcium gluconate solution by inhalation is necessary.
8. Patients with neck, chest or head burns should be watched for delayed pulmonary edema.
9. Hemodialysis must be considered for fluoride removal and to avoid or correct hyperkalemia and recurrent hypocalcemia not responsive to replacement therapy.
10. A patient with a history of recent exposure who is experiencing respiratory irritation should be admitted immediately to an intensive care unit and observed closely for 24 to 48 hours. Administration of nebulized 2.5% calcium gluconate should be considered.
11. Do not give stimulants. Patient must remain inactive for at least 24 hours.

3.4 Oral Ingestion

1. Do not induce vomiting
2. Do not give patient any baking soda or emetics.
3. Give 250 – 750 ml of water, 500 ml bottle sterile water in kit
4. Affected person swallow 3 tablets of calcium carbonate (Tums) and transport to hospital.

Further emergency care should be performed by a physician only or licensed emergency medical personnel.

5. Gastric lavage with calcium chloride or calcium gluconate may be performed by a physician. Extreme caution must be observed when passing the Levine tube.
6. Extreme throat swelling may occur which may require a tracheotomy.

7. Patient should be admitted to a hospital intensive care unit.
8. Hemodialysis may be necessary for fluoride removal and to avoid or correct hyperkalemia and recurrent hypocalcemia not responsive to replacement therapy.

3.5 Nail Burns

1. Irrigate with water until calcium gluconate solution is available, submerge affected fingers in calcium gluconate 23% solution. Add ice to solution if available. Use ice cubes, to prevent frostbite.

Further emergency care should be performed by a physician only or licensed emergency medical personnel.

2. If pain does not completely cease, 2 to 3 holes should be drilled in the nail using an 18 gauge needle. Continue soaking.
3. If pain still does not subside, the nail must be removed by a physician. The nail bed should be massaged with 1.5% calcium gluconate gel. Infiltration of aqueous calcium gluconate 5% solution with a small gauge needle (#25-#30), around the burn and intralesionally must be used only in severe cases due to the risk of obstruction of the microcirculation.
4. Do not use calcium gluconate 5% injection without first removing the nail.
5. The use of 0.5% calcium gluconate given intraarterially has also been reported.

*Poison Control Canada does not recommend that lay persons trephine the nail nor that a physician remove the nail and infiltrate the bed. This is a painful and disfiguring procedure. It is our recommendation that intra-arterial injection of calcium gluconate be done under radiologic control if possible.

4.0 Supplies

Medical supplies must be readily accessible at all times.

See List in Appendix A.

HF Antidote Gel for external use; 2.5% calcium gluconate gel
Rubber or PVC gloves for persons treating HF burns/injuries

5.0 Training

5.1 Persons working with HF/Fluorine Compounds:

Employees must be trained in the following wearing of personal protective equipment (PPE), in the hazards of HF, its effects and in this emergency response procedure.

5.2 Managers:

Managers will be trained in the use of PPE, in the hazards of HF, its effects and in this emergency response procedure.

5.3 Emergency Response Personnel

McMaster University Security and EFRT (Emergency First Response Team) will be trained in the use of PPE, in the hazards of HF, its effects and in this emergency response procedure.

5.4 Hamilton Health Sciences (HHS) Emergency Medicine:

EOHSS will provide information and orientation to HHS with regards to the McMaster University Hydrogen Fluoride Emergency Response Program and its requirements.

6.0 Reporting and follow up

1. Complete a McMaster University Injury and Incident Report.
2. Complete a summary of the first aid administered to the injured person.

7.0 Information for presentation at Emergency medicine services

The injured person will take with them to Emergency:

1. Notice of HF Emergency
2. MSDS
3. Summary of treatment
4. McMaster University Hydrogen Fluoride Emergency Protocol

This information will be present in all labs and work areas where fluorides are present and/or handled and contained in a plastic pouch for transport with the injured person.

8.0 References

Air Products and Chemicals Inc. Hydrofluoric Acid Burns: Health Effects and Treatment Plan for Medical Professionals and Emergency Responders; Approved 1/97, Rev. 6/02 and 6/03

Appendix A

First Aid Supplies

It is extremely important that medical supplies be acquired and kept on hand in sufficient quantities at all times. Some of supplies are difficult to acquire and must be ordered. Others must be prepared by a pharmacist, and a few require a doctor's prescription. The immediate application of first aid using HF specific medical supplies is the key to a positive outcome; rapid and successful recovery from HF absorption.

1. Calcium gluconate 2.5% gel
2. Calcium gluconate 23% solution
3. Basins – assorted sizes for immersion
4. Ice cubes
5. Triangular bandages for wet compresses
6. Gauze, compression dressings
7. Pliers - open 23% Calcium gluconate solution
8. Sterile 0.9% saline 500 cc IV bag
9. Sterile water for injection 500cc
10. Tums – calcium carbonate tablets
11. Eye irrigator - syringe to irrigate the eye
12. First Aid shears/scissors – to open saline bag
13. Eye wash
14. Safety shower
15. Pocket mask to give rescue breathing
16. Rubber/PVC gloves
17. Tyvek coats
18. Safety glasses

Appendix B

Material Safety Data Safety Sheets

Appendix C

HF First Aid Summary Report

Name: _____

Injury Date: _____ **Injury Time:** _____

Injury Description: _____

Dermal: _____

Inhalation: _____

Ingestion: _____

Nail Bed: _____

Eye: _____

Supervisor's Name: _____

Room/Location/Building: _____

Contact phone Number: _____

Person Administering First Aid: _____

Contact Phone Number: _____

Time of Treatment: _____

Name of Drugs/Solutions administered: _____

First Aid Measures taken: _____

Appendix D

McMaster University Injury and Incident Report

Appendix E

Medical Facilities

McMaster University Medical Centre
Hamilton Health Sciences
Emergency Department
1200 Main Street West
Hamilton, ON
905-521-2100

Hamilton General Hospital
Hamilton Health Sciences
Emergency Department
237 Barton Street East
Hamilton, ON
905-527-0271

St. Joseph's Hospital
Emergency Department
50 Charleton East
Hamilton, ON
905-522-4921

Appendix F

Emergency Treatment Sign for Transport with Injured Person