

HF EXPOSURE
TREATMENT GUIDE
FOR
PHYSICIANS

University of Southern California

Environmental Health and Safety

HF Exposure Treatment Guide for Physicians

Introduction

Hydrogen fluoride is a highly corrosive chemical that can cause severe and deep burns on exposure. It is imperative that medical assistance be provided for any exposure to HF and the treatment be initiated promptly. Hydrogen fluoride differs from other corrosive chemicals in that the fluoride ion readily penetrates the skin causing destruction of deep tissue layers including bone. However, its critical harmful effect comes from the action of the fluoride (F^-), not acid burn. Fluoride ion from HF forms such a strong bond to Ca^{2+} in bones. It reaches to bones and leaches calcium from bones and may tie up calcium in nerve cell. This disruption of nerve condition can be life threatening when disrupting a heart function.

Skin contact

Topically applied calcium gluconate gel (2.5 percent) must be rubbed-in continuously until pain has completely subsided. Calcium gluconate gel should not be used until after complete (at least 15 minutes) washing of the skin with water. After the pain has subsided, the calcium gluconate gel should be rubbed-in for 30 minutes at 3 or 4 hour intervals. If the skin burns are deep or extensive, calcium gluconate gel, 2.5%, should be massaged into the skin for 3 to 4 days, 4 to 6 times daily. Care should be taken to see that personnel who apply the gel, especially on the initial application, wear rubber gloves to prevent skin contamination with HF and possible development of hand burns.

In cases where skin burns are greater than 25 square inches (160 cm^2) in area, hypocalcemia may be present. Therefore, systematic administration of calcium gluconate may be necessary. Frequent monitoring of serum calcium, renal and hepatic functions is necessary.

When there is evidence of skin penetration as in second or third degree burns, a 5 percent calcium gluconate solution (the standard ampule is 10 percent for intravenous use) may be injected by infiltrating the skin and subcutaneous tissues in the same manner as the injection of a local anesthetic. Care should be taken to avoid overdosing with calcium. All skin which has been exposed should be infiltrated including up to $\frac{1}{4}$ inch (6 mm) around the area. This may prevent the development of severe burns.

Burns around the fingernail may require splitting the nail from the distal end in order to relieve pain and facilitate draining prior to soaking with one of the above-mentioned solutions.

Immediate excision of small areas burned with concentrated solutions of HF may prevent a painful, slow-healing burn. Primary closure after excision of skin grafting, if indicated, may provide more rapid healing and less scarring.

Eye Contact

Immediate washing of the eyes with large quantities of water while holding eyelids apart for at least 15 minutes should be followed by ice packs. The ice packs should be used until a medical facility is reached. Here the eyes should be washed thoroughly with 1 percent calcium gluconate in normal, sterile saline for 5 to 10 minutes, thereafter, calcium gluconate in normal saline should be instilled every two or three hours for 48 to 72 hours. No oils or ointments should be used. Inflammation may be decreased by the use of corticosteroid solutions for ophthalmic use. An eye specialist should be consulted immediately.

Vapor Inhalation

Persons exposed to HF by inhalation should be given 100 percent oxygen by mask or catheter. As soon as possible, they should be given 2.5 to 3 percent calcium gluconate solution by inhalation, preferably by intermittent Positive Pressure Breathing (IPPB) utilizing a nebulizer, or by nebulizer alone. The patient should be carefully watched for edema of the upper airway with respiratory obstruction and the airway maintained by tracheostomy or endotracheal intubation if necessary.

If pulmonary edema develops, the patient should be placed on IPPB with Positive Expiratory Pressure (PEEP). The administration of respiratory care should be very closely supervised, including the administration of calcium gluconate by inhalation. Toxicity from pulmonary absorption of fluoride ion may rapidly develop in the liver and kidneys and may require more energetic measure of control, up to and including hemodialysis, if the blood urea nitrogen and potassium rise. Supportive care is necessary for all organ systems.

Ingestion

Apply first aid measures as needed, including having the patient drink a large quantity of milk or water with added milk of magnesia. Do not induce vomiting. Throat burns may cause severe swelling and require a tracheostomy. The patient should be administered to the hospital and carefully watched.

Medical Supplies

- Calcium gluconate gel, 2.5 %
(Keeping a commercial grade calcium gluconate gel at the work site is highly recommended for an emergency)
- Calcium gluconate, 1 % normal, sterile saline solution
- Calcium gluconate, 10 % for injecting (standard ampule). Use 5 percent solution mixing equal quantities of calcium gluconate and sterile normal saline.

To make a 5 % solution of calcium gluconate for subcutaneous injection in HF burns, mix equal amounts of sterile 10% calcium gluconate solution and sterile normal saline.

To make a 2.5% solution of calcium gluconate for inhalation exposure to be given by nebulizer, mix one part of 10% calcium gluconate with three parts of sterile normal saline.

25cc 10% calcium gluconate with 225cc normal saline = 1% eye solution

Preparation of Calcium Gluconate Gel

- Heat a measured amount of K-Y Jelly (Johnson & Johnson) to 50-60°C, typically 395 gram
- Add 2.5% by weight of calcium gluconate, reagent grade, slowly with good stirring until all dissolved.
- An alternate method of adding the calcium gluconate is to add 2 grams and stir in until mostly dissolved, then add the remaining calcium gluconate (added to 35 cc of H₂O)) with good stirring until dissolved into the jelly
- Finished gel will be water-clear with many air bubbles which can be removed by allowing the bubbles to rise to the surface after standing
- The above quantities will fill eleven four ounce jars approximately three quarters full

Additional Information

Article: M.A. Trevino et al, J. Occ. Med., 25, p. 861

Product Information, EI. DuPont De Nemours & Company, 1-800-441-7515 (product) or 3637 (medical assistance)

M.A. Trevino et al, J. Occ Med., 25, p. 861