

Caustic Hypocalcemia: Hydrofluoric Acid Burn

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Abstract

Hydrofluoric acid is a strong inorganic acid. It differs from other acids in that the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers and even bone. Burns caused by hydrofluoric acid can be life-threatening. The specific antidote, calcium gluconate, can be applied topically, injected into tissue or infused intra-arterially. Emergency medical teams should be familiar with the symptoms and of hydrofluoric acid exposure and should be ready to respond properly in case of emergency. In this paper, we present a case of hydrofluoric acid poisoning due to accidental exposure to hydrofluoric acid. (*JAEM 2014; 13: 39-40*)

Key words: Hydrofluoric acid, calcium gluconate, chemical burn

Introduction

Hydrofluoric acid (HF) is a strong inorganic acid. It is widely used in many industrial fields, including chemicals, fertilizers, pesticides, plastics, dyes, leather tanning, electrical sets and semiconductor manufacture (1-4). HF can cause an initial caustic injury. Accidents commonly affect the fingers (3). The onset of erythema and pain may be delayed up to 24 hours after exposure with concentrations lower than 20% (1, 3, 5). The skin may appear normal initially, with only mild erythematous lesions, thus giving the false impression that the outcome will be favorable and erroneously downplaying the need for care (3). In this paper, we present a case of HF poisoning due to accidental exposure to HF.

Case Presentation

A 41-year-old farmer presented to our emergency department (ED) following local contact with hydrofluoric acid (HF). The patient stated that he had found a plastic bottle in the woods and some of the liquid inside the bottle spilled on his hand as he was examining it. The spill caused immediate and intense pain on his hand and he flushed it with a copious amount of water before seeking help at a local hospital. He was referred to our ED 11 hours after the incident. The patient was fully alert and oriented upon presentation and complained of intense pain in the right hand. His vital signs were: pulse 100 bpm, blood pressure 120/80 mmHg and temperature 37°C. He had suffered a third degree chemical burn to the surface of the

palm and first and second fingers of the right hand, excluding the fingernails, resulting in a blister 3 cm in diameter, edema and necrosis (Figure 1). His motor and sensory capacities were diminished on the injured fingers and he complained of intense local pain. The rest of his physical exam was unremarkable. His calcium and other electrolyte levels were all within normal limits and he presented with a normal sinus rhythm on ECG. His wounds were cleaned with povidone-iodine and covered with a burn dressing. A tetanus shot was given and he was admitted to the plastic surgery service. Topical calcium gluconate was not given since the injury had occurred 11 hours earlier. Instead, 10% calcium gluconate was given intradermally without significant improvement. A split skin graft was applied by plastic surgery under general anesthesia. The injury site was found to have improved one week after the surgery (Figure 2).

Discussion

HF readily penetrates the skin and mucous membranes, causing deep tissue destruction. In addition, HF exposure may lead to systemic complications due the potential for fluoride ions to penetrate the skin. Fluoride binds to calcium, increasing cell membrane permeability to potassium. The severity and rapidity of the onset of signs and symptoms depend on the concentration, duration of exposure and penetrability of the exposed tissue (2). Burns involving as little as 2.5% of the body surface area with concentrated HF have caused fatal hypocalcemia-related cardiac arrhythmias and death (1, 2).

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Figure 1. Lesions after 11 hours from exposure

First aid is very important immediately after an HF burn. Immediate irrigation of the affected area with water followed by application of a topical agent to neutralize fluoride ions minimizes injury (1). Calcium gluconate gel has been widely used in the first aid of HF burns (1-3). However, in an experimental hydrofluoric acid burn treatment study, topical calcium gluconate treatment was found to be ineffective when application was initiated 6 h or more after HF exposure (6). The combination of calcium gluconate and dimethyl sulfoxide (DMSO) may have a significant role to play in first aid treatment. This treatment also has the advantage of not requiring trained medical personnel for administration (1). Calcium gluconate is not available in gel form in Turkey. Instead, clinicians may create a gel by mixing calcium gluconate powder in 150 ml of water and adding a lubricant, such as a K-Y jelly to the mixture.

Intradermal injection of a 10% calcium gluconate solution (never calcium chloride) is usually reserved for cases of failure of gel treatment or for those cases that are more severe (1). Intradermal or subcutaneous application, around and into the affected area, can be of help in cases of lesions in which the subcutaneous tissue is loose enough to support gluconate deposits without interfering with normal blood circulation (7). Therapy should be continued until pain relief is achieved (1).

Regional intravenous perfusion of calcium gluconate for the treatment of digital HF burns has been reported (1, 3). Intravenous calcium gluconate or magnesium sulfate must be given when a serum calcium and magnesium imbalance is detected. Regional intravenous infusion of calcium can be used for finger lesions using a Bier block technique (3, 8). However, intra-arterial calcium gluconate administration is recommended for the treatment of burns involving the hands, especially the fingers (1, 7, 8). This saves the patient from having to suffer through the recommended nail removal when there is subungual involvement (1).

The use of local anesthetics is not favored because this may mask the adequacy of treatment. In cases of extreme pain, however, local anesthesia may be necessary although pain relief can then no longer be used to guide therapy (1).

Consequently, burns caused by HF are potentially life-threatening. Patients suffering from minor HF splash injuries should be treated in hospital. Emergency physicians should be familiar with the



Figure 2. Split skin graft after one week

physical signs of these injuries and be prepared to properly intervene after taking appropriate personal protective measures.

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