



# Case #99

NAME Educational Activities Committee

Case provided by:

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Photograph courtesy of Dr. Delfín Francisco Delgado

1. A 33-year-old male was instructed to use a pressure wand to wash commercial trucks. Soon after starting, he lost control of the wand causing the cleaning solution to spray him on several body areas. He immediately sustained several severe burns. The incident reports shows that first-aid was given at the scene with calcium gluconate.

What ingredient was in the cleaning solution?

- Concentrated ammonia
- Sulfuric acid
- Oxalic Acid
- Hydrofluoric acid

Answer...

**D. Hydrofluoric acid** – (CORRECT ANSWER, 44.80 % of responses)

Hydrofluoric (HF) acid is an extremely powerful inorganic acid and a vigorous dehydrating agent that is used for many industrial purposes. When in aqueous solution, cutaneous exposure is the most frequent route of administration. HF is highly lipophilic and readily penetrates the skin into deeper tissue. Clinically, the morbidity of the burn is directly proportional to the concentration of HF, the duration of exposure, and the immediacy and adequacy of first aid measures.

There are three mechanisms of injury:

1. Corrosive burns with immediate contact to the skin, eyes, respiratory and gastrointestinal mucous membrane. The burns cause intense pain with visible tissue destruction, areas of ulceration and necrosis.
  
2. Penetration of the dermal layer by the fluoride ion: The fluoride ion differs from other forms of acid that release hydrogen cations in that the fluoride ion continues to dissolve through the skin provoking further destruction of nerves, blood vessels, underlying soft tissues, muscles, and bone structures.
  
3. Electrolyte imbalances leading to disturbances of renal, hepatic, and cardiac function:
  - a. Reaction with cellular calcium and magnesium forms insoluble chelates of  $\text{CaF}_2$  and  $\text{MgF}_2$  leading to hypocalcemia and hypomagnesemia.
  - b. Inhibition of the  $\text{Na}^+\text{K}^+$  ATPase pump causing hyperkalemia.

## Treatment:

The procedure to treat HF burns prevents ongoing HF absorption, and blocking the progressive destruction caused by fluoride ions. Treatment for HF burns includes irrigation with water and application of 2.5% calcium gluconate until there is pain relief. Calcium gluconate chelates free fluoride ions to form an insoluble calcium salt making it the primary neutralizing agent for HF.



Other responses...

## **A. Concentrated ammonia (24.00 % of responses)**

Ammonia is a highly irritating gas with a sharp suffocating odor. It is found in household and industrial-strength cleaning solutions. Exposure to high concentrations causes immediate burning of the eyes, nose, throat and respiratory tract and can result in blindness, lung damage or death. Swallowing ammonia can cause burns to the mouth, throat and stomach. There is no antidote for ammonia poisoning. Instead, large amounts of water are used to irrigate affected areas.

## **B. Sulfuric acid (17.60 % of responses)**

Sulfuric acid is a common chemical used in a wide variety of manufacturing processes. It is a corrosive chemical that can severely burn the eyes and skin. Exposure to sulfuric acid mist can irritate the eyes, nose, throat and lungs, and at higher levels cause pulmonary edema. To neutralize sulfuric acid on skin, the recommendation is to flush the contact areas with soap and lukewarm water for a minimum of 30 minutes.

### C. Oxalic acid (13.60 % of responses)

Oxalic acid is a colorless to white, odorless powder that is used as a rust and ink remover, and radiator cleaner. It is corrosive and contact can severely irritate and burn the skin and cause eye damage. First aid involves flushing the eyes with water for at least 30 minutes and washing skin with large amounts of soap and water. In the body, oxalic acid combines with metal ions such as  $\text{Ca}^{2+}$ ,  $\text{Fe}^{2+}$ , and  $\text{Mg}^{2+}$  to deposit crystals of the corresponding oxalates, which irritate the gut and kidneys. Ingestion of ethylene glycol results in oxalic acid as a metabolite that can lead to acute kidney failure.

# REFERENCES

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