NOTES ON HYDROFLUORIC ACID BURNS

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SUMMARY: Intensive treatment with 10% calcium-gluconate injections and with local anesthetics for relief of severe pain are recommended for HF burns. Thorough washing of the lesions with soap and water, debridement of the area and, if necessary, excision of necrotic areas are indicated.

Hydrofluoric acid is the watery solution of HF. It is a colorless, fuming fluid with a boiling point of 19.5°. In the glass industry it is used for etching, polishing or rendering glass opaque; in the metal industry, for processing surfaces. It is also employed in galvanizing and cleaning the outside walls of buildings.

With the expansion of the use of hydrofluoric acid (HF) in industry, the incidence of burns by HF and its vapors has been increasing. In most cases the uncovered face and hands are affected. Even if the hands are protected by loose rubber gloves, the fluid may run inside of the gloves. The eyes are vulnerable to splashes from the acid.

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Hydrofluoric acid is used commercially in a 40% solution. Its immediate effect upon the skin, an unpleasant drawing sensation, soon turns into extreme pain. A white discoloration of the skin, which ensues locally, develops into grey-blue blisters. When the blisters break, if untreated, the surface of the wound expands further for approximately 6 days. Necrosis below the surface of the skin, however, continues for about 5 weeks. If the concentration of HF is 60%, there is a latent period of several hours before the changes occur. A 10% solution is without danger if removed promptly from the skin (Fig. 1).

In contrast to other acid burns which lead to coagulation necrosis, hydrofluoric acid induces a colligation necrosis which progresses rapidly and requires an extraordinarily long period for healing.

Haar (1) believes that the lipoid-soluble HF molecule penetrates the intact epidermis and settles below it where it precipitates tissue calcium and induces cellular and tissue necrosis. Simon-Weidner and Dreher (2) attribute this particular kind of burn to the low degree of dissociation of HF.

**Fig. 1**

Burn of Fingers with 50 to 60% HF (after 2-3 hours)

As treatment, Fredenhagen (3) recommended injections of a 10% calcium-gluconate solution. In 1962, Thiele and Wild (4) added hyaluronidase to the calcium solution in order to enhance its effect by anchoring it in the injection area. They recommended injections into and below the affected tissue designed to precipitate insoluble non-toxic calcium fluoride. They also advocated bathing and moist dressings with calcium gluconate and debridement of the blisters. Treatment should be continued until the pains disappear. Up to three injections may be given in 24 hours. In this manner Harr (5) and Beck (6) claim to have avoided the formation of necroses and to have induced healing.

Brandt and Behrbohm (7), Kleine-Nathrop (8) as well as Klavis, et al. (9) have failed to note any essential shortening of the healing period due to

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the calcium treatment. In animal experiments Simon-Weidner and Dreher (2) could not confirm the precipitation of calcium fluoride crystals following the injections. They doubt that the chemical reaction of \( \text{Ca} + 2\text{F} = \text{CaF}_2 \) occurs at the tissue level and point particularly to the state of low disas- sociation of HF which would interfere with formation of \( \text{CaF}_2 \). Indeed, when they injected calcium fluoride into healthy tissue they observed consider- able damage such as edema, formation of fibrin, diapedesis of leucocytes and necrosis of muscle tissue. In the treated rats, healing time was signifi- cantly prolonged compared with that in untreated control animals. Therefore, they do not favor this treatment. Dreher demonstrated that the necrotic area increased after each local injection.

At the Oststadt Klinik, Mannheim, four cases with HF burns on the hands were treated with calcium injections and subaxillary local anesthetics. The following is a case report:

A 20 year old building-maintenance worker sustained an HF burn by a 50 to 60% hydrofluoric acid solution which had run inside his gloves. Two to three hours later he experienced pain in all finger tips which gradually became intolerable. He was treated for 3 days with calcium gluconate injections com- bined with a subaxillary nerve block using novocain until the pains disappeared.

**(a)**

_Same case (after 7 days)_

_Cupnea Necrosis_

**(b)**

_Same case 3 1/2 Months Following_  
_Surgical Debridement_

After 7 days the superficial soft tissue of the finger tips had sequestered. The scars were surgically repaired at a later date.

Treatment of HF burns by local injections is still subject to contro- versary. Washing the lesions with soap and water, brushing up to the point of

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bleeding, mechanical removal of the acid depot by removal of the blisters are recommended. If necessary, the necrotic areas should be excised. They can be sharply delineated by means of disulfine stain. Moist compresses and baths with calcium gluconate solutions seem to be of little value. Antibiotics have been recommended. The use of gluco-corticoids is desirable because of their anti-inflammatory and proliferative action.

Even when the lesions appear to be harmless, early surgical treatment is imperative in order to prevent expansion of the process into wider areas.

Bibliography