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Case report

Importance of initial management and surgical treatment after hydrofluoric acid burn of the finger

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ABSTRACT

Occupational injuries to digits due to hydrofluoric acid (HFA) are frequently encountered. They have distinctive features, including intense pain, progressive tissue necrosis, and possible bone erosion. To minimize tissue damage, it is of great importance to execute prudent preoperative assessment and determine the correct surgical modality to reconstruct and maintain the function of the hand. However, proper protocols for fingers have not been presented in previous studies.

Eight cases with HFA burn to digits were presented to the emergency room. Wounds were immediately irrigated with saline, calcium gluconate was applied topically to block destructive effects of fluoride ions. Blisters that could lead to progressive tissue destruction were debrided. A fish-mouth fasciotomy was performed and prostaglandin was administered intravenously to maintain maximal distal circulation. Wounds were evaluated daily for apparent demarcation for 6 or 7 days. Digits were reconstructed with free sensate second toe pulp-free flap to provide sufficient padding for the fingertip. All patients showed excellent recovery with stable flaps with acceptable external contour, durable soft tissue padding, and full range of motion of affected joints.

In conclusion, when a patient is admitted due to HFA exposure to the finger, early treatment including irrigation, topical neutralizers, and fasciotomy are of great importance to minimize tissue damage. In addition, a physician should wait at least 7 days until the degree of damage to the tissue can be classified so that the physician can decide whether aggressive debridement should be proceeded. In case of deep layer injuries of weight bearing portions such as finger pulp, reconstruction techniques utilizing durable tissues such as partial second toe pulp free flap should be employed.

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1. Introduction

Hydrofluoric acid (HFA) is an inorganic acid used to polish glass, melt silica, or eliminate rust from aluminum [1]. Occupational injuries to digits due to HFA exposure are frequently encountered with distinctive features, including intense pain, progressive tissue necrosis, and possible bone erosion [2].

The degree of injury to a finger due to HFA exposure can be determined by the density of HFA and what appropriate action has been taken at the time of exposure [3,4]. Higher density of HFA will cause more damage that could result in systemic effects [4]. However, even if the HFA is of low density, the degree of damage can be serious if there is insufficient first aid or if the tissue has been exposed for a long time. In particular, fingers receive blood supply via the ends of arteries. Therefore, a deep injury may interrupt blood circulation, leading to amputation.

A physician treating a patient with a HFA-burned digit must decide whether to maintain conservative care, whether the wound should be surgically debrided, when to surgically debride the wound, whether reconstruction in needed, and what type of reconstruction should be performed after the debridement.

However, proper protocols for fingers have not been presented in previous studies. No evidence-based guideline is currently available for surgery time or method. Treatments for fingers remain controversial [4,5]. Here, we share our center's methods to care for patients whose digits were exposed to HFA.

2. Patients and methods

The Institutional Review Board of the Catholic medical center of Korea approved the current study. A retrospective chart review was performed for HFA burns to fingers of patients who visited our hospital from August 2013 to January 2016. A total of eight patients were identified. We summarized two cases.

2.1. *Case 1*

A 69-year-old male was admitted. His index finger and thumb were exposed to HFA while washing a water tank (Fig. 1A). The digits were irrigated immediately with saline. Calcium gluconate was applied topically to block destructive effects of fluoride ions. Blisters that could lead to progressive tissue destruction were debrided after irrigation was started. A fish-mouth fasciotomy was performed (Fig. 1B). Prostaglandin was administered intravenously to maintain maximum distal circulation. Serial plain radiographs were ordered to preclude delayed osteolysis. Electrocardiogram was monitored to check systemic effects. Calcium gluconate was applied topically for 2 days until the pain stopped. It was difficult to analyze the precise depth of the dead tissue due to blisters and yellow eschar during the first 2–3 days. However, tissue necrosis was stopped 6–7 days later. The degree of damage was classified (Fig. 1C). The tip and the pulp that had direct contact with HFA underwent total necrosis. Debridement was executed on day 9 (Fig. 1D). A free sensate partial second toe pulp-free flap was used to reconstruct the pulp area where the injury was deep. The remaining areas were treated with split thickness skin graft.

2.2. *Case 2*

A 52-year-old male was admitted. His right middle finger was exposed to HFA at a construction site. He did not go to the emergency department until 2 days after the injury (Fig. 2A). Initial treatment was executed as described for case 1. It was difficult to determine the precise depth of dead tissue in the first 2–3 days. However, tissues necrosis was stopped 6–7 days later. The tip and pulp areas that had direct contact with HFA had undergone total necrosis (Fig. 2B). Other areas close to the basal layer of the dermis layer were preserve. Debridement was executed on day 8. Necrosis was detected as deep as the

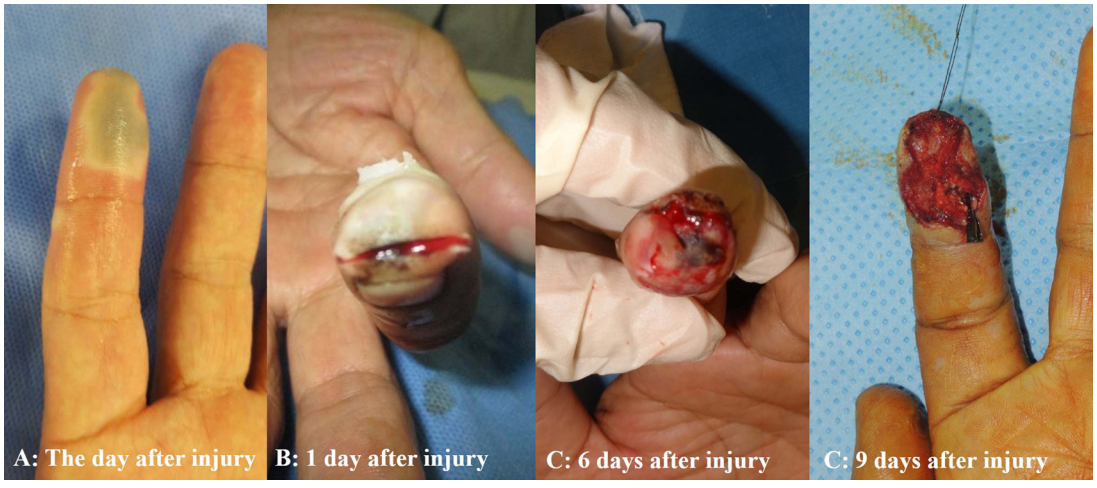

Fig. 1 – Case 1: (A) a 69-year-old male was admitted due to exposure to hydrofluoric acid (HFA) of the index finger and thumb while washing a water tank. (B) Fish-mouth fasciotomy incision was performed 1 day later. (C) Tissue necrosis was complete. The degree of damage could be classified 6-7 days later. (D) Debridement was executed for the deeply injured areas. Necrosis was detected at the base of the tendon.

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