

Efficient emergency first aid decontamination of major hydrofluoric acid exposures with Hexafluorine®

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Introduction

Hexafluorine® is a specific first aid emergency rinsing solution for the decontamination of eye/skin hydrofluoric acid (HF) splashes⁽¹⁾, produced by PREVOR Laboratory⁽²⁾, in France. Using its hypertonicity and chelating properties, Hexafluorine® is able to contain the double danger of HF: Hexafluorine® absorbs the corrosive H⁺ ions and stops the toxic effects by binding the toxic fluoride(F⁻) ions. Hexafluorine® stops the penetration of the chemical product⁽³⁾ and removes from the tissues the amount of HF that has already penetrated thanks to the hyperosmolar Conclusion pressure⁽⁴⁾.

Materials and methods

The Medical, Health and Safety Services of the CRISTALLERIES d'ARQUES and the AVESTA factories decided to introduce Hexafluorine® for rinsing hydrofluoric acid splashes and to train workers to use it correctly. The previous protocol of rinsing was water followed by a topical ointment with 2-3% calcium gluconate gel⁽⁴⁾. Hexafluorine® was introduced in the AVESTA factories because the latest protocol (water + calcium gluconate gel) did not always avoid the appearance of the burn and the sequelae due to the hydrofluoric acid. Ocular and cutaneous chemical splashes must be rinsed in emergency (within a minute) with Hexafluorine®, on location, while undressing if necessary. In case of eye splashes, a quantity of 500 mL of Hexafluorine® is used for one minute of contact. A cutaneous splash involves the use of an Autonomous Portable Shower (DAP) with 5 liters of Hexafluorine® within one minute following the accident. Then each person goes to the Medical centre for an examination. In the AVESTA factory, the workers are sent to the Malarhospital in Elkistuna. The CRISTALLERIES d'ARQUES factory has chosen to keep calcium gluconate gel ointment for use after the first rinsing with Hexafluorine®. Hexafluorine® is a medical device CE0459 first classifying and sterile. Hexafluorine® is a non toxic⁽⁵⁾ solution (Oral toxicity LD₅₀>2000 mg/Kg, test 990553 1999 CERB). It is non irritant on the skin (Test 133/7 1987 Safepharm Laboratories, UK) and the eye (Test 133/8 1987 Safepharm Laboratories, UK).

Results

A CASE REPORT OF A 70% HF VAPOUR EXPOSURE⁽⁶⁾
RINSED WITH HEXAFLUORINE®
in the CRISTALLERIES d'ARQUES, in FRANCE, 1997

A 35-years-old male technician received

a splash of 70% HF vapor
on his right cheek

while he was opening a valve in the hydrofluoric acid circuit. He felt an immediate sensation of strong pain. His eyes protected with safety glasses were not exposed. As he was working with an Autonomous Portable Shower (DAP) of Hexafluorine® near him, he was able to decontaminate himself immediately. According to the protocol, he used the entire 5 liters of Hexafluorine® delivered in about 6 minutes of rinsing. He went to the nursery where only a small and painless erythema was noticed. The following day, another examination showed that the erythema was nearly resolved and always painless. As a precaution, a topical ointment with 3% calcium gluconate gel was applied.

**RESULT : IMMEDIATE PAIN RELIEF,
NO SEQUELAE,
NO LOSS OF WORK**

A SERIE OF 16 HF SPLASHES
involving two 70% HF splashes
RINSED WITH HEXAFLUORINE®

in the AVESTA factories, in SWEDEN (1998-1999)

During 1998-1999, there were 16 ocular and cutaneous accidents involving hydrofluoric acid. 80% of the exposed workers were males and they were all aged 39±11 years. The third of the workers were exterior intervening people. Two chemical splashes involved 70% HF and the others a mixture of hydrofluoric acid and nitric acid (HNO₃) at a pH value of one. In one case, the mixture HF/HNO₃ included sulfuric acid (H₂SO₄) at the same pH value of 1 and involved both facial and eye splashes. Two cutaneous splashes with the pickling acid (mixture HF/HNO₃) were warmed at about 40-45°C. The splashes were all rinsed first with Hexafluorine® and the rinsing started within a minute in 75% of the cases. Three splashes with diluted HF/HNO₃ mixture were rinsed after an hour of contact. All the workers noticed an immediate pain relief during or after the rinsing with Hexafluorine®. More than 60% of the workers were sent to the hospital for a medical examination. There was no damage. The ocular splash with the unknown HF concentration involved a delayed irritation some hours after the accident. It is a possible reaction to the aggressiveness of the washing with Calcium gluconate at the Hospital. In a facial and oral cavity warmed splash with HF/HNO₃ pH=1, some blisters on the outside of the eyelid were noticed the day after the incident.

N° Cases	Exposure	Body surface	Time of contact	Loss of work
2	70% HF	Left forearm - Oral cavity	< 1 min	0 - 1 day
1	HF (unknown concentration)	One eye	< 1 min	0
2	HF/HNO ₃ pH=1	One eye	< 1 min	0 - 0
1	HF/HNO ₃ pH=1*	One eye	3-5 min	3 days
1	HF/HNO ₃ pH=1	Both eyes	< 1 min	0
1	HF/HNO ₃ pH=1	One thigh	< 1 min	0
2	HF/HNO ₃ pH=1	Both thighs	1h-1h30	2 - 2 days
1	HF/HNO ₃ pH=1*	Face	3-5 min	3 days
2	HF/HNO ₃ pH=1	face + oral cavity - forehead	< 1 min	1 - 1 day
3	HF/HNO ₃ pH=1	forearm - arm + hand right and left arm fold	< 1 min	0 - 0 - 1 day
1	HF/HNO ₃ pH=1	Wrist	2 h	0

* : HF/HNO₃ / H₂SO₄, pH=1 represents both an ocular and cutaneous splash

**RESULT : IMMEDIATE PAIN RELIEF, NO SEQUELAE,
IN 75% OF THE CASES
INCLUDING THE TWO 70% HF SPLASHES
NO SECONDARY CARE WERE REPORTED
AN AVERAGE OF ONE DAY LOST FROM WORK
(σ = 1.1)**

Conclusion

The emergency first aid rinsing of an hydrofluoric acid serie of splashes including three 70% HF cutaneous splashes with Hexafluorine® avoided the appearance of the typical major burns usually described with other protocols in the litterature.

References

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