HF burns: how to avoid them?

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PURPOSE

HF is a weak acid but a strong corrosive and toxic chemical with a potentially lethal risk. It is commonly used in the workplace with specific prevention and safety rules. The first aid protocol in case of splashes with HF is detailed here. Water is usually recommended as the protocol of reference, sometimes in association with calcium gluconate. We have decided to compare these commonly recommended interventions with Hexafluorine®, a specific active rinsing solution of HF splashes and its derivatives.

METHODS

The aim of this study is to review the literature for available data concerning HF burns and their decontamination, and to emphasize how new substitute studies can be linked to clinical results.

RESULTS

1. CASE REPORTS WITH WATER

Initial tap water decontamination has usually been recommended in cases of chemical splashes. Even though immediate water decontamination can decrease the severity of the burns, it often cannot prevent severe burns and sometimes ends in death (clinical and animal data). Improvements are obtained with calcium gluconate, which binds fluoride ions. Diluted HF has been successfully decontaminated with water followed by topical applications of calcium gluconate gel. Improved management of HF burns can prevent fatalities as a result of some major HF burns, but severe burns and sequelae remain.

2. IN VITRO EXPERIMENTS

Studies were conducted to analyse the impact of an effective replacement decontamination solution to replace water during as first aid washing. In vitro experiments performed at the Augenklinik, Aachen, Germany, show the benefits of slightly hypotonicosmolar washing (fibroblast culture experiments)

The comparison between different washing solution to obtain the most rapid return to a physiological pH and pF (in vitro simulation of penetration through a semi-permeable membrane) is shown in Figure 3.

CONCLUSION

New substitute experimental studies open the fields of understanding burn mechanisms and improvement of first aid, and maybe in the future, delayed management of chemical burns. Convergent data, in vitro data and ex vivo data confirm the clinical observations that an active decontamination solution for HF splashes, such as Hexafluorine®, is effective, as it is used as first aid and immediately.

REFERENCES

- Dunser et al., Critical care management of major HF burns: a case report, review of the literature, and recommendation for therapy, Burns 2004, 30, 383-388
- Söderberg et al., Hexafluorine®: an improved method for emergent decontamination of ocular and dermal hydrofluoric acid splashes, Vet Hum Toxicol 2002, 46, 4, 216-218

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(1) Prevor Laboratory, Valmondais France - http://www.prevor.com
(2) TCMTs, Inc, Laramie, Wyoming and Department of Preventive Medicine and Biometrics, University of Colorado Health Science Center, Denver, Colorado, USA.

3. EX VIVO EXPERIMENTS

Experiments were performed with the acute EVEIT model using rabbit cornea (model has been proven to react very similarly to living eye tissue concerning the behaviour during chemical eye burns) and an OCT HR (Optical Coherence Tomography).

If we follow the penetration velocity of 2.5% HF inside the cornea, we can see that it is decreasing with time due to dilution. Full corneal penetration is observed 240 s after topical application.

FIGURE 4 - Comparison between no rinsing and different washing solutions (washing during 15 minutes), 20% topical application of 2.5% HF.

This study shows a clear cornea even one hour after the end of the washing only with Hexafluorine®.

4. CASE REPORTS

32 case studies of emergency decontamination with Hexafluorine®

<table>
<thead>
<tr>
<th>No of cases</th>
<th>Splashed by</th>
<th>Affected body surface</th>
<th>Type of washing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HF/HCl 47%</td>
<td>Total immersion</td>
<td>Hexafluorine® on the body</td>
</tr>
<tr>
<td>2</td>
<td>HF/HNO3 pH=1</td>
<td>Face + oral cavity</td>
<td>Hexafluorine®</td>
</tr>
<tr>
<td>3</td>
<td>HF/HNO3 pH=1</td>
<td>Forehead</td>
<td>Hexafluorine®</td>
</tr>
<tr>
<td>4</td>
<td>HF/HNO3 pH=1</td>
<td>One thigh</td>
<td>Hexafluorine®</td>
</tr>
<tr>
<td>5</td>
<td>HF/HNO3 pH=1</td>
<td>One eye</td>
<td>Hexafluorine®</td>
</tr>
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<td>...</td>
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</tbody>
</table>

RESULTS: Immediate analogous effect with the washing with Hexafluorine® and no sequelae. Among these 32 case reports, using Dunser’s table (cf. references), 5 accidents could have presented lethal risk but no sign of systemic effect was observed when decontamination with Hexafluorine® was performed and treatment with calcium gluconate was applied with calcium gluconate if needed.

1. Slight burns on the abdomen and the back and serious burn on the left eye
2. Slight nailpsoriasis etching. Application the next day with calcium gluconate gel, no lost working time
3. Ocular and cutaneous splash with 40% HF