EVALUATION OF BURNS AND DECONTAMINATION MECHANISMS

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Introduction

Severe eye burns occur rarely, but are related to a poor prognostic in rehabilitation. An emergency treatment has been identified as a decisive factor for decreasing burns (1) based on *in vivo* and clinical data. The aim of this study is to demonstrate by in vitro experiments the theoritical model of hydrofluoric acid (HF) burning and to evaluate the interest of first aid rinsing with an active rinsing solution.

Materials and methods

Invitro experiments on cell culture were performed at the Augenklinik, Aachen, Germany and t in vitro studies of the simulation of the penetration of a toxic and a complete rinsing through a semi-permeable membrane were performed at PREVOR Laboratory, Valmondois, France.

1. Fibroblast cultures were used to show the effects of :

- HF contact through the appearance of calcium binding with Furared markers,

- an hypoosmolar (water) and hyperosmolar rinsing (Previn 800 mosmoles/Kg).

2. The other in vitro experiments simulate :

- an ocular penetration of HF through a semi-permeable membrane (model in Fig. 1),

- the efficacy of various solutions (Hexafluorine versus water or 10% calcium gluconate) on 10 mL of 0.1 N HF by simple dosage ,

- the internal decontamination of an ocular 1N HF splash rinsed with Hexafluorine versus water (Model in Fig. 2),

. the complete decontamination of an ocular 6%HF/ 15% HNO_3 (nitric acid)rinsed with Hexafluorine versus water (Model in Fig. 2).

The hydrofluoric acid or the HF/HNO_3 mixture are the agressors and the saline solution represents an internal physiological compartment of the eye, the semi-permeable membrane (Hutchinson, cellophane paper, 30g/cm^2, 2,5 micrometer thickness) simulates the cornea.

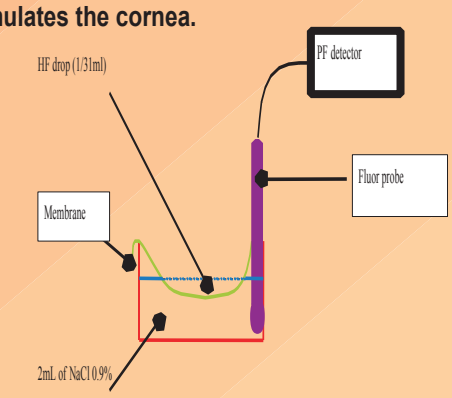

Fig. 1 : Simulation of penetration of a toxic

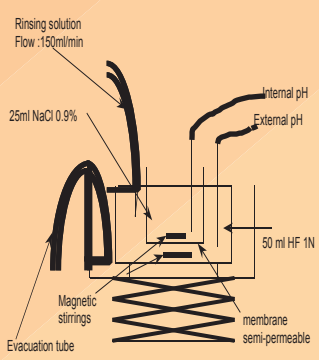

Fig. 2 : Simulation of a complete rinsing

Results

1. PENETRATION OF A TOXIC THROUGH A SEMI-PERMEABLE MEMBRANE

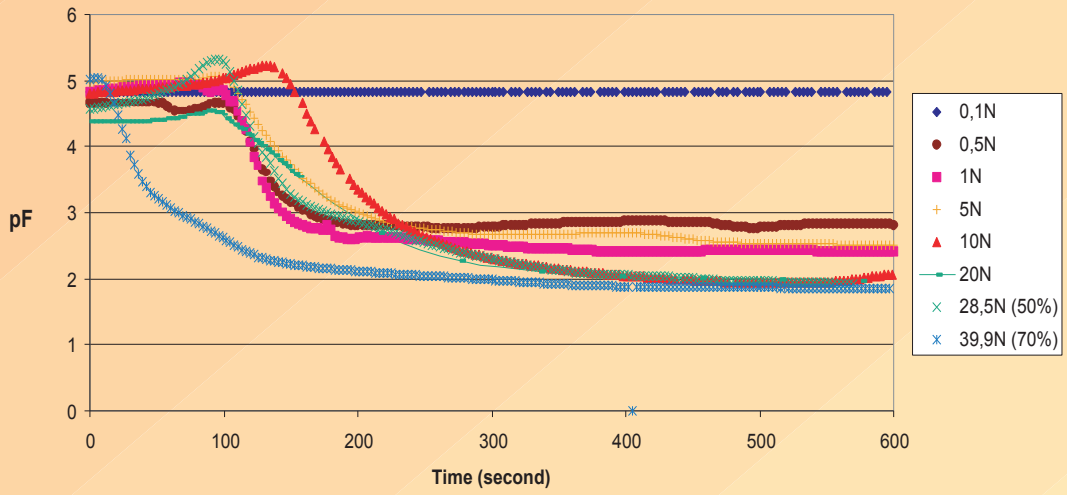

Fig 3: Penetration of HF through a plastic membrane as a function of time

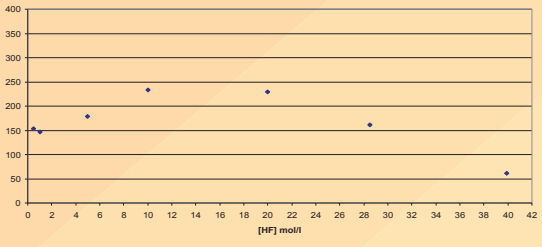

Fig 4: Half time penetration of HF through a plastic membrane as a function of [HF]

Results : There is no penetration of F$^-$ when the concentration of the drop layed on the membrane is 0.1N. With a drop of HF 1N, pF in the solution of NaCl tend to 2.5. With a drop of HF 10N, 50% or 70% pF in the solution of NaCl tends to 2.

2. SIMULATION OF A COMPLETE RINSING

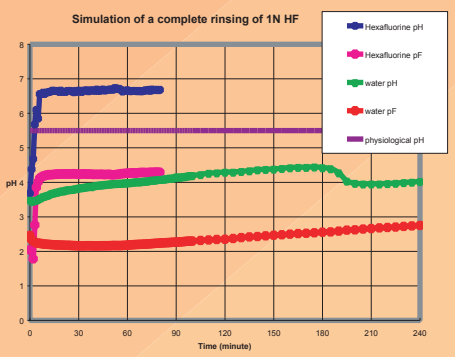

Fig.5: Evolution of the internal pF and pH of an ocular 1N HF splash

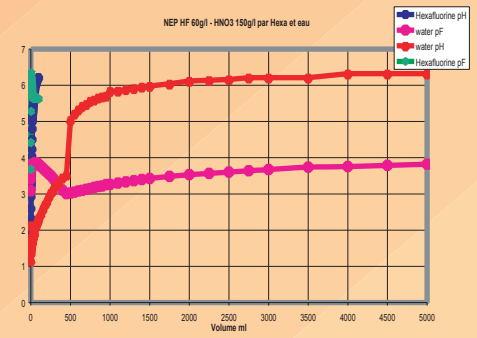

Fig. 6: Evolution of the internal pF and pH of an ocular 6% HF / 15% HNO_3 splash

Results : Hexafluorine rinsing allow a quick increase of internal pH and pF to physiological values compared to water rinsing.

3. COMPARAISON OF THE EFFICACY HEXAFLUORINE VERSUS WATER

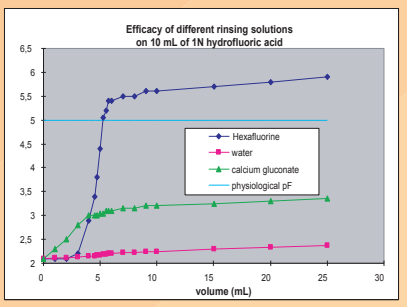

Fig. 7: Evolution of the pF

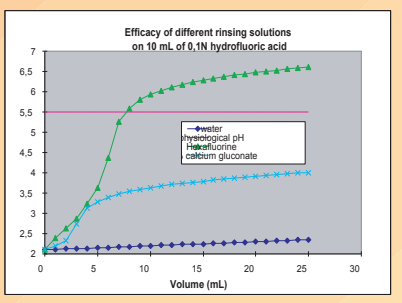

Fig. 8: Evolution of the pH

Results : This dosage shows the better efficacy of Hexafluorine versus water to allow a quick return to physiological values of pH and pF without the effect of mechanical rinsing.

4. OSMOLARITY INFLUENCE ON FIBROBLAST CULTURE

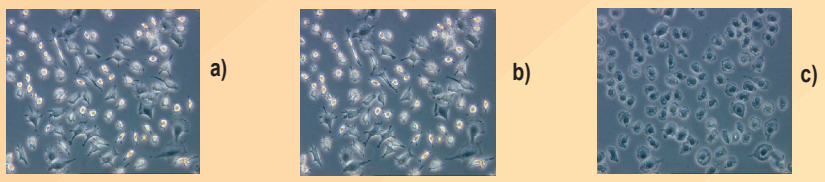

Fig. 9: Influence of hypoosmolarity, rinsing cells with water; a) before the start of rinsing; b) at the beginning of the rinsing ; c) at the end of the rinsing

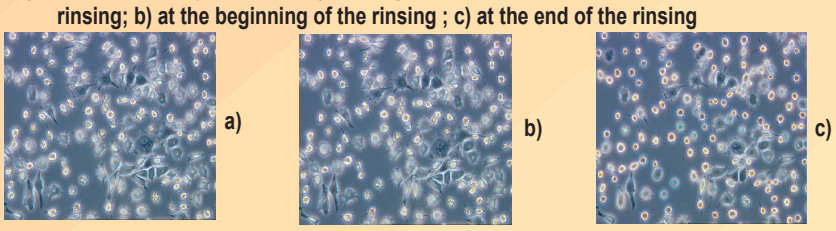

Fig. 10: Influence of hyperosmolarity, rinsing cells with Previn (800 mosmoles/Kg); a)before the start of rinsing; b) at the beginning of the rinsing ; c) at the end of the rinsing

Results : The rinsing with an hypotonic solution such as water increases the volume of cells until explosion of a certain amount of cells. The rinsing with an hypertonic rinsing solution only decreases a little bit the volume of cells without deleterious effect (2,3).

5. HF EFFECT ON FIBROBLAST CULTURE

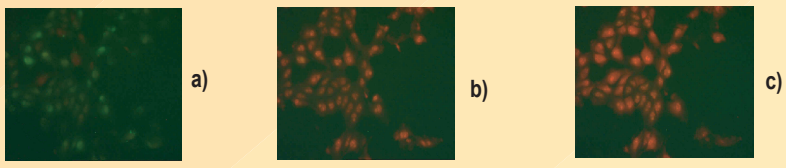

Fig. 10: Influence of HF on a fibroblast culture; a)before the start of rinsing; b) after 10s ; c) after 47s

Results : With Furared marker, the culture shows red spots due to chemical chelation of calcium by HF.

Conclusion

The *in vitro* experiments showed the importance of using an active rinsing solution such as Hexafluorine® compared to water rinsing against ocular hydrofluoric acid splashes. These results confirm the efficacy of Hexafluorine® already shown by a first aid use in industries (4,5,6): it allowed a quick return to physiological pH and pF, stopping the penetration of HF and neutralising the aggressiveness of both corrosive H^+ ions and toxic F^- ions. Further experiments will be done on the in vitro models on both simulation and cell cultures. The model of simulation could be improved by the change of the membrane, the ratio of volumes between the internal and external compartments and the osmolarity of the internal compartment. The cell cultures will be used to show the interest of an active rinsing with various concentration of Hf and times of exposure.

References

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