

Hydrofluoric acid (HF) burns: A new efficient model with *ex vivo* BIO-EC human skin explants

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Introduction

HF's very hazardous properties are due to a double mechanism of action: corrosivity (H⁺), local and systemic toxicity (F⁻). Its use is mainly industrial, including glass etching, metal cleaning, oil refinery, uranium treatment, fluorocarbon products, electronics manufacturing, refrigeration industry and photovoltaic industry.

Objective

There is a lack of experimental studies which could objectively characterize the behavior of HF on human skin: mechanism of diffusion, kinetic of penetration through the skin and the resulting cellular lesions. We propose here to describe the effects due to 70 % HF on an *ex vivo* human skin model developed by BIO-EC Laboratory in France as a technique for ethically using human skin explants¹. This skin model will allow, in the future, a comparison of first aid treatments (see poster n° 3878).

Methods

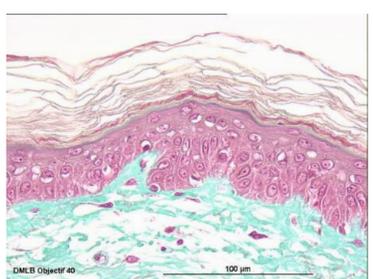
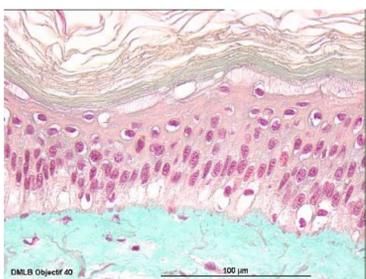
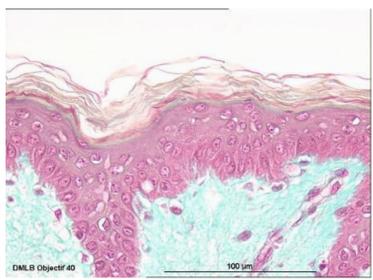
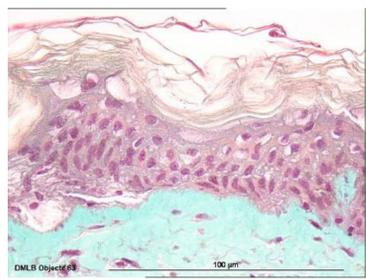
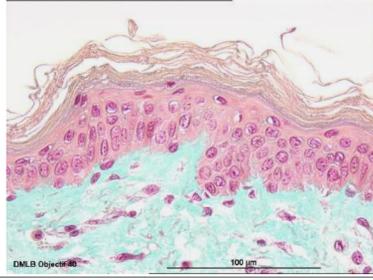
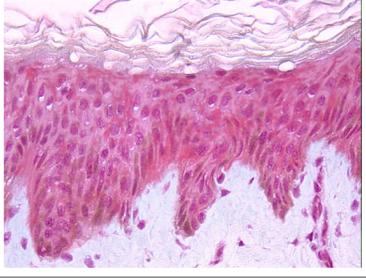
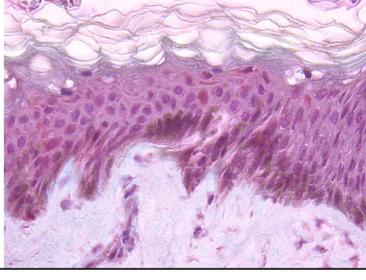
59 human skin explants prepared from abdominoplasties were preserved alive during all the experiments in a specific BIO-EC medium at 37° C in a moist atmosphere with 5 % CO₂.

HF exposure: By topical route from filter paper disks (9 mm diameter) previously saturated with 30 µl of 70 % HF.
Control group: no exposure.

Histological sampling at different times, from 1 minute up to 24 hours. Observations were performed by optical microscopy X40.

Reproducibility guaranteed by triplicate for the early part (20s to 5 minutes) and duplicate for the later observations (5 minutes to 24 H).

Results

Time of exposure	Description	Histological aspects	Time of exposure	Description	Histological aspects
20 seconds	Good morphology (No cellular alteration)		4 minutes	Epidermis and papillary dermis clearly altered (clear cytoplasm and pyknotic nuclei). Reticular dermis still clear. Clearer alteration of papillary dermis.	
1 minute	Some pyknotic nuclei and cytoplasm slightly acidophilic in the upper layer of the epidermis. Epidermic-dermic junction correct. Beginning of HF penetration in the upper epidermis		5 minutes	Epidermis and papillary dermis clearly altered. Some pyknotic nuclei in the reticular dermis. Alterations reach slightly reticular dermis. Beyond ten minutes, all four layers present significant alterations.	
2 minutes	Pyknotic nuclei and cytoplasm clearly acidophilic in the epidermis. Epidermic-dermic junction correct. Lesions reach epidermis basal layer.		1 hour	Pyknotic nuclei and acidophilic cytoplasm in all layers. Lesions remain stable until the final observation	
3 minutes	Epidermis is totally altered (edematous cells). Some pyknotic nuclei and cytoplasm slightly acidophilic in the papillary dermis. First lesions in the superficial part of dermis.		24 hours	Epidermis totally necrotic. Pyknotic nuclei and acidophilic cytoplasm in all layers. Total epidermal necrosis can be observed.	

Conclusion

Under these experimental conditions the human skin explant model is reproducible and describes the first cellular deteriorations due to 70 % HF that appear within the first minute. Full penetration is observed within 5 minutes.

The study confirms the severity and the speed of penetration of 70 % HF burns and the lesions showed by our model are in perfect accordance with both experimental data and reports of previous accidental situations. It underlines the need for early decontamination.

Moreover, this model, reacting very similarly to the practice concerning HF burns, is in accordance with new European regulations such as REACH or Cosmetics regulations. Further experiments will be performed to show the efficacy of various decontamination solutions.

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¹Bartek, MJ, LaBadde, JA: Percutaneous absorption in vitro. In: Maibach HI (ed.). Animal Models in Dermatology 1975, New York, Churehill Livingstone, pp 103-120