Introduction: Sulphuric acid (H₂SO₄) is widely used in industries. It is a strong acid which induces severe burns and can also cause thermal burns when concentrated. There is little knowledge about burns induced by sulphuric acid and the key parameters that can improve its decontamination. The purpose of this study is to show the mechanism of burns and wound healing and to start investigation on delayed decontamination, especially for the management of burned victims due to chemical accidents.

Methods:

Experiment 1: This ex vivo study aims to show the extent and nature of epidermal and dermal lesions over 48 hours (burn group) as well as the spontaneous healing process over 11 days (healing group) on 39 human skin explants obtained with consent from plastic surgery patients. The burn was made with filter paper soaked with 30 µL of 95% sulphuric acid.

Time of exposure (burn group) = Observation time / healing group = ~ 25 seconds.

Histological analysis was performed to evaluate the burn based on an intensity scale.

Results:

Damage induced by concentrated sulphuric acid appears within the first minute. Full skin lesions are observed after approximately 4 hours. No spontaneous healing of the H₂SO₄ burn was observed after 2, 6, and 11 days.

Methods:

Experiment 2: Simulation of 95% H₂SO₄ diffusion (fig. 3): This type of experiment examines the diffusion of an irritant or corrosive agent through the eye. Sulphuric acid was put on a semi-permeable membrane to imitate eye penetration and diffusion (fig. 4). Diffusion of different concentrations of sulphuric acid was evaluated by pH measurements.

Influence of dilution and chemical effect (fig. 5): This experiment is intended to show the effect of dilution and chemical activity of a decontamination solution. It also evaluates heat release during dilution of concentrated sulphuric acid in water. The dilution is evaluated with demineralised water and the chemical effect is evaluated with Diphtherite®, an amphoteric solution, by pH measurements.

Influence of mechanical effect (fig.6): The simulation of an external rinsing mainly shows the mechanical effect of a washing at the surface of the tissue. 9% sodium chloride is put in a beaker where the bottom of the beaker is replaced by a semi-permeable membrane which imitates the cornea. The beaker is then put in contact with 50mL of 95% H₂SO₄. After 10 seconds of contact, the rinsing is started in the 50mL beaker. The pH is measured in the beaker which represents the washing at the surface of the cornea. This experiment compares tap water and Diphtherite® as washing solutions with a 150ml/min flow rate.

Conclusion: On ex vivo human skin explants, first lesions appear very quickly to appear and full penetration of all the dermis layers occurs in less than 4 hours. The healing group showed that no spontaneous healing happens if nothing is done, which can explain scars and cheloids after such a splash. It confirmed the importance of early washing.

In vitro results presented here showed the need of a mechanical effect as well as a dilution and chemical effect to perform active and effective skin washing. An ex vivo study on human skin explants to evaluate the decontamination impact on both diffusion and from an histological point of view should be performed to confirm these results.

Bibliography:

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Results: The dilution effect is a minor effect of washing compared to the major mechanical effect - its efficacy is improved by the chemical effect in order to rapidly reach a physiological state. No additional heat release is observed and a lesser amount of solution is needed when Diphtherite® is used for decontamination compared to water.