Base (Sodium Hydroxide; NaOH) Skin Injury and Decontamination: In vitro, Experimental Animal, and Human Skin Explant Ex Vivo Studies

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Objective

Sodium hydroxide (NaOH) is one of the most common corrosive substances, responsible of very painful and severe burns. An efficient skin model will allow a better understanding of burn mechanisms. These results were also approximated with in vitro experiments.

Methods

In vivo method

40% NaOH exposure during 5s in 18 rabbits (1.5+/-0.2kg) on the back of each rabbits, with paper filter of 1cm² diameter on depilatoried skin (Na2S). The skin are then decontaminated with Diphoterine®, boric acid or tap water (6 rabbits in each group) after 30s. Total amount of washing solution and temperature are followed. pH value is the indicator of the washing end. After the rinsing, spontaneous healing is followed. Only desinfecting liquid is applied once each day to prevent the wound from being infected.

Ex vivo method

41 human skin explants from abdominoplasty preserved at 37°C in a moist atmosphere with 5% CO2 were exposed to 50% NaOH by topical route. Control group: no exposition. Histological sampling at different times, from 1 minute up to 24 hours. Observation was performed by optical microscopy X40.

In vitro assays

The NaOH diffusion is simulated through a semipermeable membrane of cellophane (30g/cm², 2.5 micrometers). A volume of NaOH (3 drops) is put at the surface of the membrane and the evolution of the pH is followed. Histological sampling at different times, from 1 minute up to 24 hours. Observation was performed by optical microscopy X40.

Results

<table>
<thead>
<tr>
<th>Solution</th>
<th>Consumption (ml)</th>
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</thead>
<tbody>
<tr>
<td>Diphoterine®</td>
<td>51.8</td>
</tr>
<tr>
<td>Boric acid 3%</td>
<td>60.8</td>
</tr>
<tr>
<td>Tap Water</td>
<td>110.3</td>
</tr>
</tbody>
</table>

No significant temperature changes were founded in any group. Less Diphoterine® was needed to reach a physiologically acceptable pH of 6.7. NaOH burn healing was best following Diphoterine® washing, without significant heat release.

Conclusion

This study confirms the need for an urgent and effective decontamination to prevent or minimize the severity of chemical burns due to concentrated sodium hydroxide. These results support further studies and clinical use of Diphoterine® as a skin decontamination solution in case of sodium hydroxide cutaneous splashes.