EFFICACY OF DIPHOTERINE HCl DECONTAMINATION IN RATS : A COMPARATIVE STUDY

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INTRODUCTION

Chemical burns are common. Josset et al (1984) noted that there were approximately 7,000 serious chemical burns in France during this year. In the US, the American Association of Poison Control Centers Toxic Exposure Surveillance System (AAPCC TESS) recorded 185,509 dermal and 134,669 ocular exposure cases in 1999 (8.0% and 1.3% of total reported exposures, respectively). Of these, 3,243 involved hydrochloric acid (HCl) and 9,104 involved all acids (excluding hydrofluoric acid HF]). Of the HCl cases, 1,229 cases (38%) were evaluated in a health care facility, as were 41% of all acid exposure cases. In the HCl cases with known outcome, 14% were asymptomatic, 86% had any symptoms, <1% had major symptoms, and there were 3 deaths. Of all acid (excluding HF) cases, 15% were asymptomatic, 85% had any symptoms, <1% had major symptoms, and there were 6 deaths.

Diphoterine® is an amphoteric, slightly hypertonic, polyvalent chelating water-soluble compound used as an eye/skin decontamination solution for a wide range of chemical compounds, including bases and acids. This experimental study was performed to assess the comparative efficacy of Diphoterine® versus isotonic normal saline decontamination in a rat HCl burn model. Because hydrochloric acid and hydrofluoric acid exposures have sometimes been confused, Diphoterine® was also compared to calcium gluconate decontamination.

MATERIALS AND METHODS

Animals/Decontamination:

* 25 male Wistar rats, average weight 250 grams
* Groups (N=5/group)
  - 5 controls (no HCl exposure/no decontamination)
  - 5 HCl-exposed, no decontamination,
  - 5 HCl-exposed, decontaminated for 30 seconds with normal saline,
  - 5 HCl-exposed, decontaminated for 30 seconds with 10% calcium gluconate solution,
  - 5 HCl-exposed, decontaminated for 30 seconds with Diphoterine®

Anesthesia:

* General anesthesia with 30mg/Kg ketamine during HCl exposure
* General anesthesia with ether during blood drawing

HCl exposure :

* 52% HCl, 0.5 ml instilled on the left shoulder for 15 seconds

Parameters Assessed at 6, 48 hours and 7 days following HCl exposure:

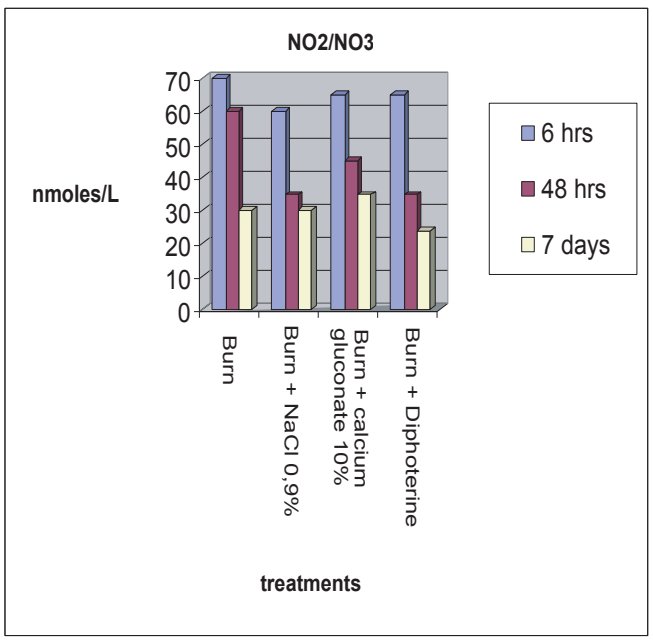
* Immunological (Plasma)
  - Interleukin-6 (IL-6)
  - Tumor Necrosis Factor-α (TNF-α)
  - Nitric Oxide (NO)

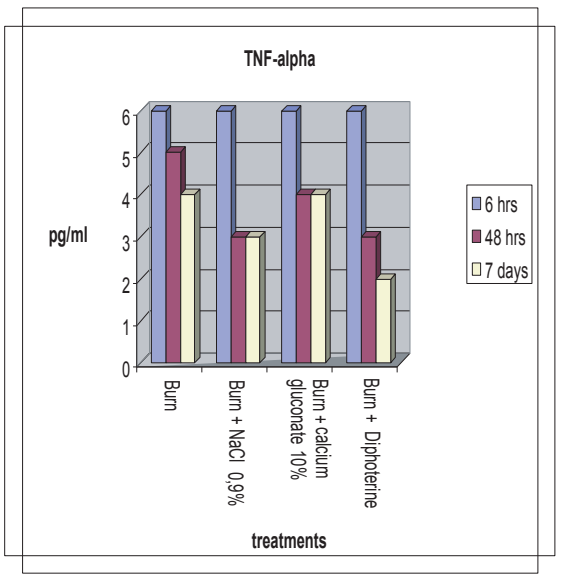
* Analgesia (Plasma)
  - β-Endorphin
  - Substance-P

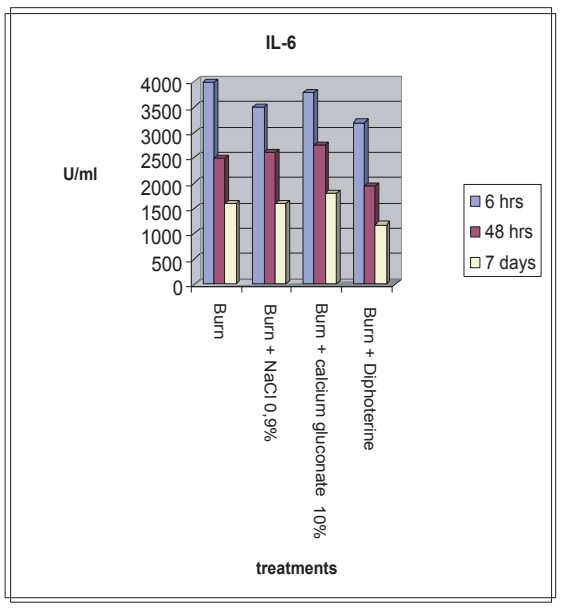
Wound healing was evaluated by evolution of the necrotic area and burn resolution.
Statistical comparisons : Mann-Whitney tests using the Unistat Program with $p < 0.05$ considered significant

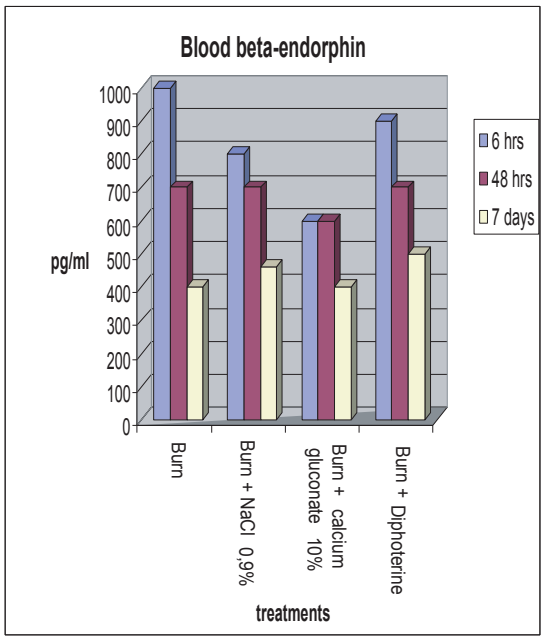
RESULTS

The results of plasma assays for *immunological* and *analgesia* parameters are shown in the following figures.









DISCUSSION

IL-6 and TNF-α production is enhanced during inflammation and following burns. NO levels also increase following a chemical burn due to an inflammatory response to the injury. In this study, the use of Diphoterine® was associated with decreased plasma levels of these parameters at 6 and 48 hours and 7 days after experimental HCl skin burns, as compared to untreated controls and following decontamination with either normal saline or 10% calcium gluconate solution.
Chemical burns are acute stress conditions causing release of endogenous opioids such as β-endorphin. When Diphoterine® decontamination was done, there was an increased release of β-endorphin and a decreased release of substance-P, indicating a lesser degree of pain in these animals as opposed to those not decontaminated or decontaminated with either normal saline or 10% calcium gluconate. Improved wound healing in the Diphoterine® decontamination group compared to controls not decontaminated or animals decontaminated with either normal saline or 10% calcium gluconate was shown by a more rapid resolution of the necrotic area and better healing of the burned tissue startingfrom the externalburn margin.

CONCLUSION

Decontamination with Diphoterine® significantly modulated plasma cytokines and opioid peptides in this experimental HCl dermal burn model, as well as promoting better wound healing as compared to no decontamination or decontamination with either normal saline or 10% calcium gluconate. These data provide further evdence that Diphoterine® represents an improvement for decontamination of acid dermal splashes.

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