

Alkali ocular burns in Martinique (French West Indies)

Evaluation of the use of an amphoteric solution as a rinsing solution

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Introduction

Chemical burns represent 7.7-18% of ocular traumas. Alkali burns are responsible for serious injuries to the stroma and to the corneal endothelium, iris, and ciliary body. Bases cause the death of epithelial cells through saponification of fatty acids in the cell membrane and also facilitate the penetration of the product into the eye. The most severe injuries are associated with the destruction of limbal stem cells (Figure 1 and 2) and result in recurring epithelial ulcerations, chronic stroma ulcers, profound stromal neovascularisation, conjunctival covering or even corneal perforation. The prognosis of chemical burns depends on the extent of the ocular surface damage degree of intraocular penetration, and the concentration and nature of the agent involved. Martinique is an island of 381.500 inhabitants in the French West Indies where burns due to alkali are frequent and severe. In addition to the description of clinical and progressive characteristics of alkali burns treated in Martinique, the principal objective of our study is the comparison of the effectiveness of the emergency use of the rinsing solutions: physiological solution and an amphoteric solution Diphoterine®.

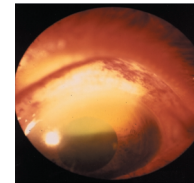
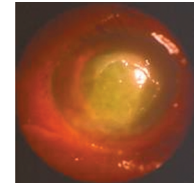


Figure 1 and 2:
Ocular burn due to Alkali (ammonia);
Limbal ischemia at the initial exam;
Evolution to a corneal recurring ulcer

In vivo studies

Penetration of ammonia through the cornea	
Material and methods	Results
<ul style="list-style-type: none">23 rabbit eyesBurn with 0.01 ml of 15.3 % ammonia during 1 minPHmeter probe in the anterior chamberpH measurement each 5 seconds	<ul style="list-style-type: none">Increasing of pH: 1 to 3 minpH maximum at 5 min: 10Curves: plateau between 2 increasingAt 30 min: weak concentration of ammoniaRate of penetration: 11 %Limited interest of rinsing after 30 min of contact

Comparison of rinsings: Diphotérine® versus saline solution	
Material and methods	Results
<ul style="list-style-type: none">18 rabbit eyespHmeter probe in the anterior chamber0.01 ml of 15.3 % ammonia during 1 min of contactpH measurements each 5 seconds250 ml of saline solution versus Diphotérine®Histology of the cornea	<ul style="list-style-type: none">Diphotérine®: inflexion of pH curve = decrease of pHWhen rinsing after 30 min: no curve inflexionEpithelial necrosis: saline solution and Diphotérine®Stromal oedema: only with saline solution

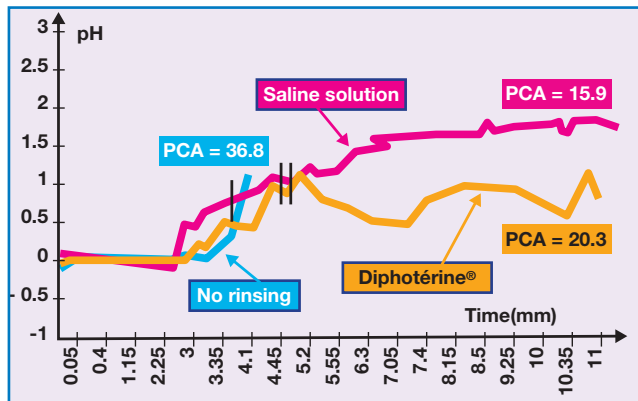


Figure 3: Rinsing 3 min after contact with 0.01 ml of 15.3% ammonia

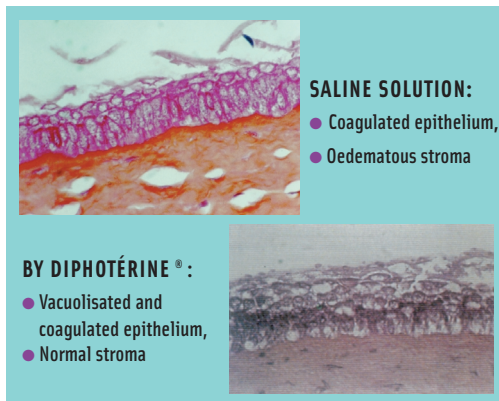


Figure 4 and 5: Histology of cornea rinsing 3 min after contact with ammonia

Clinical study

Patients and methods

This study was conducted in a prospective manner from January 1, 1998 to December 31, 2001 at the University Hospital Center of Fort de France in Martinique. For each patient, we noted the exact nature of the product causing the burn, the circumstances, and the delay between the accident and the first ocular irrigation performed by the victim or by a third party. The delay between the accident and the first action taken at the hospital, which is immediate ocular irrigation, was noted. A complete ophthalmologic exam was performed and the ocular injuries were classified according to the Roper-Hall modification of the Hugues classification system (table 1). The time elapsed to the corneal reepithelialisation was specified, as well as the final best corrected visual acuity and the incidence of complications if applicable. Whichever rinse product used, the same therapeutical protocol was applied (table 2), at the difference that 500 ml of physiological solution was applied from January 1, 1998 to December 31, 1999 and 500 ml of Diphoterine® was used from January 1, 2000 to December 31, 2001. After the rinsing, one drop of Dexamethasone was instilled all 20 minutes until ophthalmologic exam (table 2). The progression of the injuries was not carried out blindly. The exploitation of the data is carried out in a strictly anonymous, computerised manner. The statistical tests used are: chi-square for the comparison of the frequencies, Fischer's exact test (chi-square with Yates correction for small sample size), and Student t-test for the comparison of means.

Grade	Initial clinical exam
1	Epithelial ulcer, no limbal ischemia
2	Corneal oedema, ischemia < 1/3 limbal circumference
3	Total corneal ulcer, ischemia > 1/3 and > 1/2 limbal circumference
4	Opaque cornea with non visible iris, ischemia >1/2 limbal circumference

Table 1: Classification of Roper-Hall; Grade 1, 2: good prognosis / Grade 3, 4: bad prognosis

Burns of 1 and 2 grade	Verification of antitetanic vaccination, rifamycine 6 times/day, 2% ascorbic acid 6 times/day and tropicamide 6 times/day.
Burns of 3 and 4 grade	Verification of antitetanic vaccination, rifamycine 6 times/days, 2% ascorbic acid 6 times/day, dexamethasone associated with neomycine 6 times/day during 7 days, 1% atropine 3 times/day, 1 gram of ascorbic acid by oral way 3 times/day and placing of anti-symblepharon rings. complete corneal reepithelialisation.

Table 2: Therapeutical protocol settled by the ophthalmologist after the exam following the rinsing of each burnt eye by 500 ml of physiological solution or Diphoterine® and instillation of dexamethasone

Main results

Between January 1, 1998 and December 31, 2001, 66 patients presented an ocular burn due to base, the total number of eyes burned is 104. There are two times as many men as women (45/21). The average age is 38.2 +/- 14.8 years. Alkali is the most commonly used product: 32 cases (48.5%). Alkali contains 15.3% ammonia and has a pH of 12.8. In decreasing order of frequency, the circumstances surrounding the burn are: assaults in 45.5% of cases (n=30), work-related accidents in 32% of cases (n=21) and domestic accidents in 23% of cases (n=15). Forty-eight eyes (46%) were rinsed with physiological solution and 56 eyes (54%) with Diphoterine®. Table 3 compares the progress of the burns according to product used for the second rinse.

	Total (n=104)	Physiological (n=48)	Diphoterine® (n=56)	p value
Grade 1	52 (50%)	17 (35.4%)	35 (62.5%)	2.10 ⁻³
Grade 2	32 (30.8%)	16 (33.3%)	16 (28.6%)	
Grade 3	12 (11.5%)	7 (14.6%)	5 (8.9%)	
Grade 4	8 (7.7%)	8 (16.7%)	0	
Eyelid burns	44(42.3%)	29 (60.4%)	15(26.8%)	0.0005
Delay of 1st rinse (min)	53 +/- 142	76.3 +/- 177	33 +/- 100	0.009
Delay of 2nd rinse (h)	4.7 +/-7.3	3.5 +/- 4.7	5.8 +/-8.9	0.57 NS
Reepithelialisation (d)	9 +/- 14.2	16.3 +/- 18.8	3.7 +/- 5	10-7
Grade 1	4.9 +/- 9	11.1 +/- 1.4	1.9 +/- 1	10-7
Grade 2	7.7 +/- 7.5	10 +/- 9.2	5.6 +/- 4.9	0.02
Grade 3	38.9 +/- 23	45.2 +/- 23	20 +/- 14.1	0.21 NS
Final visual acuity	20/22 +/- 20/70	20/25 +/- 20/70	20/20 +/- 20/200	0.01
Complications				
Corneal opacity	9 (8.7%)	7(14.5%)	2(3.5%)	0.03
Perforation	3 (2.9%)	2 (4.1%)	1(1.8%)	ns

Table 3: Overall characteristics of ocular burns and results of rinse solutions

Conclusion

The emergency treatment of an ocular burn proposed long ago is the rinse with water or better by isotonic solutions such as physiological solution without any demonstration of intrinsic pharmacologic effectiveness. Diphoterine® seems better in terms of its mechanism of action and the experimental results obtained. Compared to the physiological solution, the healing time of corneal scarring from grade 1 and 2 burns is shorter with Diphoterine®. For grade 3 and 4, there are not enough cases to judge the effectiveness of rinse with Diphoterine® but a case report with a grade 4 rinsed with Diphotérine® followed by an adapted treatment healed within 180 days without graft.

Main references

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A case report of a severe burn Grade 4 before the beginning of the clinical study

- Woman, 49 years old, assault at work place
- Grade 4 right eye
- Visual acuity < 1/10
- Limbic ischemia on 360°
- Scleral necrosis
- Diphotérine® : 1 hour after the splash
- Decrease of stromal oedema (AV 0.3)
- Healing after 180 days without graft

