Allergic contact dermatitis to 1-bromo-3-chloro-5,5-dimetilhydantoin

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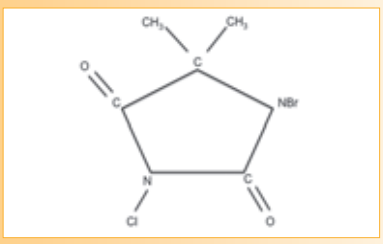
Introduction

Bromo-3-chloro-5,5-dimethylhydantoin (BCDMH) (Fig. 1) is a chemical substance structurally related to hydantoin. It is a white crystalline compound with a slight bromine and acetone odour. It is insoluble in water, but soluble in acetone. BCDMH is an excellent source of both chlorine and bromine as it reacts slowly with water releasing hypochlorous acid and hypobromous acid[1]. It is used as a chemical disinfectant for recreational water and drinking water purification. BCDMH was described as responsible of an epidemic irritant contact dermatitis in Great Britain (1983)[2]. Fitzgerald et al (1995)[3] and Sasseville et al (2004)[4] postulated a BCDMH sensitizing capacity after the demonstration of positive patch test reactions to Halobrome® and ProGuard® solutions in four patients. Two of such cases developed on swimming pools frequent users. The recommended BCDMH patch testing concentrations are 1% to 2% aq[5].

Fig. 1. Chemical structure of 1-bromo-3-chloro-5,5-dimethylhydantoin.



Aim

Two cases of BCDMH related contact dermatitis are presented. The clinical features, patch testing protocol and possible clinical relevance are discussed. The immunoallergic study was carried out according the Helsinki declaration principles and the international patch testing guidelines.

Case Report

CASE 1.

A 36-year-old woman with irrelevant past medical history, complained of a generalized and recurrent papulo-vesicular for the last 6 months. The patient worked as a swimming teacher, and she used to stay inside the swimming pool for two to three hours a day, at least three times per week. The rash developed always immediately after the exposure to the water in a particular swimming pool. This swimming pool was disinfected with the BCDMH product at concentration of 2.5 to 3 ppm (authorized limit 3-6 ppm). In contrast, she did not experienced similar symptoms after exposure to chlorinated swimming pools. When referred to the dermatologist, she did presented an itchy papulo-vesiculous rash on her axillae and trunk (Fig. 2a, 2b), forearms and limbs. A biopsy specimen was obtained. Histologically a mild lymphohistocytic perivascular infiltrate with multiple eosinophils was observed. A routine blood test did not detect abnormalities in cell blood count, proteinogram, liver and kidney function tests. IgE was in normal range and autoimmune profile and serologies for hepatitis virus B and C were negative. The European baseline series with other selected allergens included in the Spanish baseline patch test series and BCDMH obtained directly from the product were studied, at 5%, 1%, 0,1%, 100 ppm, 10 ppm and 1 ppm in petrolatum. A strong eczematous reaction with vesicles (D4+++) to BCDMH at 10% and 5% concentrations, was observed. Erythematous infiltrated papules (D4 ++) also developed at 1 ppm and 100 ppm (Fig. 3a).

Fig. 2a-b. A papulo-vesiculous rash localized in the axillae (a), trunk (b) and limbs was demonstrated after challenge test.

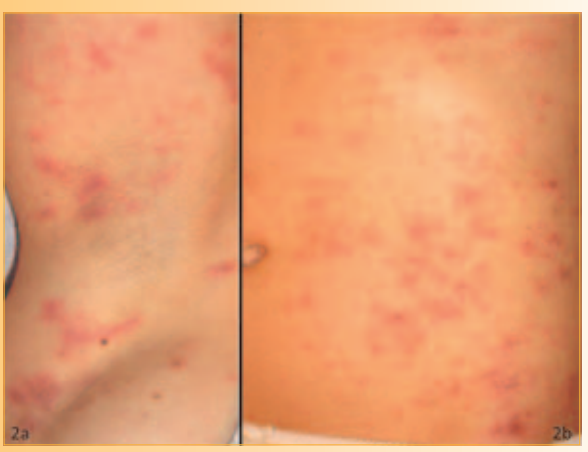


Fig. 3a-b. Patch test with BCDMH at differents concentration diluted in petrolatum in Patient 1 (3) and Patient 2 (4). An eczematous reactions beyond the limits of the Finn Chamber® was observed.

NBrCONC1C OC(CH3)2	VEHICLE	48 h	96 h
10%	PET	+++	+++
5.0%	PET	+++	+++
1.0%	PET	-	++
0.1%	PET	-	++
100 ppm	PET	-	++
10 ppm	PET	-	+
1.0 ppm	PET	-	+

NBrCONC1C OC(CH3)2	VEHICLE	48 h	96 h
5.0%	PET	+++	+++
1.0%	PET	-	+++
0.1%	PET	-	-
100 ppm	PET	-	-
10 ppm	PET	-	-
1.0 ppm	PET	-	-

CASE 2.

A 38-year-old man referred a twelve-month history of recurrent itchy papules over the trunk and axillae, always developing after water exposition to a swimming pool. No similar eruption developed after exposure to spa water or to other swimming pools. The patient used to stay inside the swimming pool for at least one hour three times per week. This particular swimming pool water responsible of the symptoms was disinfected with BCDMH. A patch test protocol with BCDMH at 5%, 1%, 0,1%,100 ppm, 10 ppm and 1 ppm in petrolatum was applied. A positive eczematous reaction (D4+++) at 1% concentration with the specific product was observed after 96 hours (Fig. 3b). Similar to the first case, an allergic contact dermatitis to BCDMH was diagnosed.

Furthermore, 16 healthy controls were also tested with BCDMH at 5%, 1%, 0,1% in petrolatum. One of them demonstrated a mild (D4+) positive reaction at 1% concentration at 96 hours.

Material and Methods

The recommended baseline series from European Environmental Contact Dermatitis research Group (EECDRG) and other selected allergens included in Spanish baseline series (GEIDAC) were applied using 8 mm aluminum Finn Chambers® on Scanpor® and fixed to the back with an adhesive tape such as Micropore® paper 3M. BCDMH for patch testing was prepared by Pharmacy Department with grinded tablets in petrolatum at concentrations of 10%, 5%, 1% 100ppm, 10ppm, 1ppm. Routine patch test exposure time was 2 days, and the results were recorded according to the international guidelines. The standard positive outcomes (allergic reaction) of the patch test was defined as a morphological + to +++ reaction between 2 days (48 h, D2) and day 4 (96 h, D4). Sixteen healthy controls were also studied with the BCDMH preparations. After full explanation each patient and control provided written informed consent to participate in this study protocol. The diagnostic study was conducted in compliance with the Declaration of Helsinki and applicable local and European laws and regulations.

Discussion

Few studies focused on swimming pool activities-induced health problems have been published and skin disorders in swimming pool workers seem to be underreported on the medical literature. Some well-established environmental predisposing factors for such disorders include heat and humidity (out of water), heat and wetting (in water), wetting and drying agents, degreasing agents, infections and chemicals[6].

The first review on skin disorders in swimming pool workers was published in 2005[7]. A questionnaire was administered to one hundred and ninety hidrotherapists and 44% of them referred to suffer from several skin disorders, most of them corresponding to contact dermatitis. Seventy per cent of hidrotherapists presented cutaneous symptoms after 6 month of being recurrently exposed to swimming pool water. As previously was described with nickel hypersensitivity a mild increase of skin disorders frequency was observed in patients with smoking habit. However, some limitations of this study can be pointed out: the recorded skin disorders were self-reported, and no patch testing was performed. Moreover, as far as we are concerned no studies comparing the prevalence and the severity of the skin disorders developing in swimming pools disinfected with brominated or chlorinated products (or other disinfectants) have been published.

BCDMH is a chemical substance highly effective to destroy waterborne Pseudomonas[1], which has been introduced since 1980 as a substitute for chlorinated products. However, this substance seems to have a higher skin irritation potential and several cases of dermatitis detected among pool users and hydrotherapists have subsequently been reported. Brominated-based products induced persistent itch without a rash, occasionally plaques, discoid or diffuse eczema and even wheals. Cutaneous signs and symptoms worsened when the exposition time was increased[9]. These observations were assumed to correspond to irritant dermatitis[8] and no patch tests to brominated-based disinfectants were performed.

Nevertheless, four cases of allergic contact allergic dermatitis to BCDMH have been published[3,4]. In such cases patch tests with the recommended product concentrations and related substances, such as sodium hypochlorite 1% aqueous, 1% and 0.5% aqueous solutions of brominated-based were performed. A similar approach has been applied in our cases. Our first patient developed an eczematous reaction to BCDMH after 96 hours at a concentration of 1 – 10 ppm in pet. whereas in patient 2, positive results to BCDMH were observed at 1% in pet. Interestingly, the positive result observed in patient 1 was elicited by BCDMH concentrations below the normally allowed levels in swimming pools. In both cases, the BCDMH swimming pools concentrations were within the authorized range (3 – 6 ppm). Clear-cut positive patch test results (the recommended published concentration of BCDMH patch test is 1 – 2% aq.[5]) along with the negative reactions observed in the control group, permitted us to establish the diagnosis of allergic contact dermatitis to BCDMH.

Finally, it is important to stress the potential occupational relevance of allergic contact dermatitis to BCDMH. In our first case, the skin disease developed in a swimming teacher and was so severe that interfered his daily working activities when BCDMH was present as disinfectant at the swimming pool.

Conclusions

The diagnosis of allergic contact dermatitis secondary to substances with a potential well-recognized irritant activity may be in some instances very difficult. Development of pruritus, itchy rashes and exceptionally eczematous eruptions after exposure to brominated swimming pools and spa water seems to be an underreported and underdignosed phenomenon which frequently corresponds to an irritant dermatitis. Allergic contact dermatitis to BCDMH seems to be a rare event. In our cases, clear-cut positive patch test results to BCDMH, along with the negative reactions observed in the control group, supported the diagnosis of allergic contact dermatitis. We report the first case of allergic contact dermatitis to BCDMH with occupational relevance.

References

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