

Airborne allergic contact dermatitis caused by didecyldimethylammonium chloride in a geriatric nurse

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For surface disinfection in hospitals and nursing homes, preparations containing aldehydes such as formaldehyde, glutaral, or glyoxal, as well as quaternary ammonium compounds (QACs), are being used. Occupational allergic contact dermatitis (OACD), including airborne dermatitis, caused by these compounds is a well-known problem in nurses and hospital cleaners (1–6). For diagnostic purposes, only one QAC, namely benzalkonium chloride (BAC), is commercially available as a patch test preparation. We report a case of airborne OACD caused by a different QAC in a geriatric nurse.

Case report

In May 2009, face dermatitis preferentially affecting the eyelids developed in a 31-year-old non-atopic geriatric nurse who had been working in the same nursing home for 13 years. The dermatitis resolved when she was off work, and reappeared quickly when she returned to the nursing home. Her dermatologist diagnosed occupational airborne contact dermatitis. Apart from an intolerance to costume jewellery since her youth, she had not had any

skin problems before. In February 2010, a patch test was performed with a baseline series, ointment bases, and preservatives. Apart from strong allergic reactions to nickel sulfate and cobalt chloride, no reaction occurred. In spite of topical treatment with corticosteroids, dermatitis continued to relapse work-dependently, spread to the neck and the backs of the hands, and led to inability to work several times. At work, the patient used a hand disinfectant based on ethanol (without isopropanol), a liquid soap, and a hand cream, all of which contained fragrances. In the nursing home, the preparations listed in Table 1 were used for cleaning and surface disinfection. In September 2010, the patient underwent inpatient treatment in a rehabilitation clinic, where a second

Table 1. Allergologically relevant ingredients of surface disinfectants and cleaning agents used in the nursing home

Product	Ingredients
Disinfectant spray	Glutaral, fragrance
Bath disinfectant	Didecyldimethylammonium chloride, benzalkonium chloride, fragrance
Surface disinfectant	Didecyldimethylammonium chloride, polyhexamethylene biguanide, Trideceth-4, fragrance
Floor cleaning agent	Ethyl diglycol, fragrance, methylchloroisothiazolinone, methylisothiazolinone, benzisothiazolinone
Universal cleaning agent	Fragrance, methylisothiazolinone, benzisothiazolinone

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Table 2. Patch test results with fragrances and ingredients of products from the patients' workplace listed in Table 1

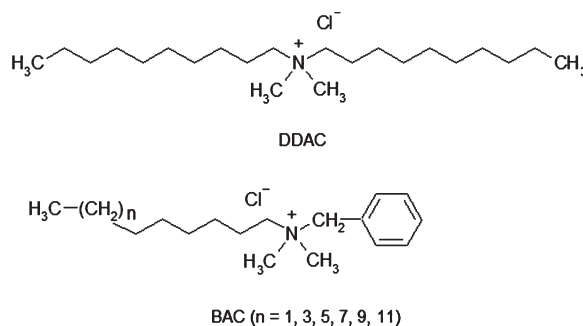
Compound/patch test substance (CAS no.)	Test concentration	Producer	Reaction at D1	Reaction at D2	Reaction at D3	Reaction at D4
Ingredients of fragrance mixes I and II, further fragrances to be declared, additional fragrances and essential oils (45 patches)	—	A	—	—	—	—
Didecyltrimethylammonium chloride (CAS 7173-51-5)	0.01% pet.	P	—	?	?	?
Didecyltrimethylammonium chloride (CAS 7173-51-5)	0.1% pet.	P	+	++	+	+
Polyhexamethylene biguanide-HCl (CAS 27083-27-8)	2.5% aqua	P	—	—	—	—
Polyhexamethylene biguanide-HCl (CAS 27083-27-8)	5.0% aqua	P	—	—	—	—
Trideceth-4 (isotrilecanol, ethoxylated) (CAS 69011-36-5)	5.0% pet.	P	—	—	—	—
Ethylidiglycol [2-(2-ethoxyethoxy)ethanol] (CAS 111-90-0)	10.0% pet.	I	—	—	—	—
Benzalkonium chloride (CAS 8001-54-5)	0.1% pet.	A	—	—	—	—
1,2-Benzisothiazolin-3-one, sodium salt (CAS 2634-33-5)	0.1% pet.	A	—	—	—	—
Methylisothiazolinone (CAS 2682-20-4)	0.05% aqua	A	—	—	—	—

A, Almirall Hermal, Reinbek, Germany; P, kindly supplied by the producer of the surface disinfectant; I, in-house preparation; ?, doubtful reaction (few papules only); +, erythema, infiltration, papules; ++, erythema, infiltration, vesicles.

The exposure time was 2 days, except for didecyltrimethylammonium chloride 0.1% pet., which was exposed for 1 day only. All patches were read at D1.

**Fig. 1.** Patch test reactions to didecyltrimethylammonium chloride (DDAC) 0.01% pet. and 0.1% pet. at D4.

patch test was performed. This time, the rubber series and the disinfectant series of the German Contact Dermatitis Research Group [Deutsche Kontaktallergie-Gruppe (DKG)], including glutaraldehyde 0.3% pet. and BAC 0.1% pet., as well as the hand disinfectant, the liquid soap and the hand cream from the patient's workplace, were tested, with negative results. Prick testing with aero-allergens also gave negative results. After the patient returned to work, severe relapse of the face dermatitis occurred, leading to a long-lasting inability to work.

**Fig. 2.** Chemical structures of didecyltrimethylammonium chloride (DDAC) and benzalkonium chloride (BAC).

In March 2011, the patient was sent to our department by the statutory accident insurance authority. Additional patch testing was performed with fragrances and other ingredients of occupational contactants (Table 2). Patch tests were performed according to International Contact Dermatitis Research Group and DKG guidelines (7), with Finn Chambers® on Scanpor®; the patch test exposure time was 2 days, except for didecyltrimethylammonium chloride (DDAC; CAS 7173-51-5) 0.1% pet., which was removed because a positive reaction with erythema and infiltration was already seen at D1. One day later, a few additional vesicles had developed, which disappeared the next day. At 0.01% pet., DDAC elicited a reaction with

few papules on the edge of the test area only, which were confluent in the further course of patch test reading (Fig. 1). Both concentrations of DDAC were patch tested with an exposure time of 2 days in a control person (author J.G.). The higher test concentration elicited an erythematous reaction at D2, changing to a typical soap effect, that is, an irritant reaction, at D3, whereas the patch test with DDAC 0.01% pet. continued to give a negative result. We diagnosed an airborne OACD resulting from sensitization to DDAC in our patient. As her employer could not change the hygiene practice in the nursing home by omitting the use of DDAC, the patient unfortunately had to leave her job.

Discussion

As proved by patch testing, our patient had clinically relevant sensitization to DDAC, resulting in an airborne OACD. This QAC, containing two aliphatic chains with 10 carbon atoms each, is chemically different from BAC, which is a mixture of QACs with aliphatic chains of 8–18 carbon atoms and another aromatic substituent consisting of a benzylic moiety (Fig. 2). Like BAC, DDAC is found in many surface and instrument disinfectants. Up to now, only a few cases of allergic contact dermatitis and contact

urticaria caused by DDAC have been described (8–11). In 1 patient with allergic contact dermatitis caused by DDAC, BAC was also patch tested, with a negative result, as in our patient (9).

We assume that contact allergy to DDAC is under-reported, because no established patch test preparation for DDAC is available. In the Occupational Contact Allergy Network, which was an Information Network of Departments of Dermatology research project funded by the German statutory accident insurance authority (Deutsche Gesetzliche Unfallversicherung; project FP 272) from April 2008 to May 2011, patch tests with DDAC at 0.1% and 0.01% pet were performed in 8 patients. With the higher test concentration, one ++, one +, two irritant and four negative reactions were seen at D3. The lower test concentration of DDAC elicited one erythematous reaction and seven negative reactions (J Geier, H Lessmann, A Krautheim, A Schnuch, unpublished data 2011). As DDAC has a certain irritant potential, we would recommend continuing patch testing with DDAC at two concentrations, that is, 0.1% and 0.01% pet., for the time being. However, it may be that, as with BAC (12, 13), in spite of its irritant potential, the higher DDAC test concentration has to be preferred in the long term in order not to miss relevant allergic reactions.

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