

Allergic contact dermatitis from propellants in deodorant sprays in combination with allergy to ethyl chloride

W. G. VAN KETEL

Department of Dermatology, Free University Hospital, Amsterdam, The Netherlands

Allergic contact eczema from the use of deodorant sprays is sometimes caused by sensitization to the propellants. Positive reactions were seen in three patients when patch testing to Freon 11 (trichloromonofluoromethane). One patient also reacted to Freon 12 (dichlorodifluoromethane). Another patient had an eczematous eruption after ethyl chloride was sprayed on the skin prior to taking biopsy. The two other patients showed strongly positive patch tests with this compound. Further investigations of the sensitizing capacity propellants with chemical resemblance have to be carried out to solve the problem of cross-sensitization.

Key words: allergic contact eczema – deodorant sprays – ethyl chloride – Freon 11 and 12.

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Allergic reactions to deodorant sprays are mostly due to perfumes, less often to disinfectants (e.g. hexachlorophene, iodochlorohydroxyquinoline, benzalkonium chloride). Certain cream bases (lanolin) and emollients such as isopropylmyristate (Calnan 1968, Wilkinson 1969) are also possible sensitizers.

We examined three patients with contact eczema of the axillae caused by one of the two or both propellants (Freons) occurring in the applied deodorant sprays. These are Freon 11 (trichloromonofluoromethane) and Freon 12 (dichlorodifluoromethane). From studying the dermatologic literature, very little data about the sensitizing capacity of these Freons is given. Fisher (1973) regards them as non-sensitizing. Crow (1973), however, described a patient suffering from acute dermatitis after using a spray for the

relief of a wasp sting; strongly positive patch test reactions were found to trichloromonofluoromethane and dichlorodifluoromethane which were present in the spray.

Materials and Methods

Patch testing was performed with:

1. The standard series (I.C.D.R.G., Fregert 1974)
2. A battery of 11 current deodorant sprays
3. Freon 11 and 12, present in the sprays separately or as a mixture
4. Ethyl chloride. This compound was only tested in patients 2 and 3.

This investigation was indicated by the deterioration of the eczema in patient 1, who was sprayed with ethyl chloride to perform a punch biopsy (see case 1). The two Freons and ethyl chloride were sprayed on 1 cm²

areas of the back for ten seconds. During the spraying the areas were surrounded by a thick layer of cotton-wool covered with a plastic sheet; in this way no contamination of the rest of the back was possible. After spraying, the patch test materials were fixed immediately because of the high volatility of the sprays. The distance from the sprays to the body was about 8 cm. The patch test materials were removed after 24 hours, while readings were done 24, 48 and 72 hours after patch testing, according to the recording criteria of Fisher (1973).

The removal after 24 hours was done in order to compare the reactions at that time with the reactions after 48 and 72 hours. If the reactions after 24 hours were stronger than after 48 and 72 hours, an argument to consider the reactions as toxic might be accepted.

In patient 3, open patch testing with the sprays was performed. Large areas became eczematous by the extensive spreading of the sprays. This method was therefore abandoned in patients 1 and 2.

Fifteen control persons with no history of eczema of the axillae and without any skin eruption were examined in the same way as the patients.

Case 1. A 32-year-old female patient was patch-tested after having suffered from an acute eczema of the axillae from using a new deodorant. From the history it appeared that she could not tolerate any deodorant spray, nor any other spray preparations such as hair lacquer.

Patch testing with the standard series of the I.C.D.R.G. showed two positive reactions (both ++) after 48 hours with iodochlorohydroxyquinoline (Vioform®) and formaldehyde: these substances may occur both in deodorant sprays and antiperspirants (Fisher 1973). Strong reactions (+++) developed with the test battery of 11 current deodorant sprays; furthermore, the reaction

to Freon 11 was clearly positive (+++), while Freon 12 did not cause any reaction. To be sure that the reaction to Freon 11 was an allergic one, histological investigation was carried out; local anaesthesia was obtained by spraying with ethyl chloride. After 12 hours, an extensive weeping eczema far beyond the original patch test with Freon 11 was seen. All patch test reactions were strongest after 48 and 72 hours; after 24 hours only one plus (+) reactions were seen.

The histological picture of the positive patch test site, as well as of the eruption after applying ethyl chloride, was compatible with the clinical picture of acute eczema: spongiosis, intra-epidermal vesicles, perivascular infiltrate of lymphocytes and macrophages in the dermis.

Case 2. A 29-year-old female patient was examined because of repeatedly relapsing vesicular eczema of the axillae after applying deodorant sprays. Patch test reactions with some of the I.C.D.R.G. series (standard, plastic, glues and organic dyes) were all negative. All tested deodorant sprays (in addition to ethyl chloride) showed very strongly positive reactions (+++). The reaction to Freon 11 was two plus (++) while Freon 12 did not show any reaction. All positive reactions were strongest after 48 and 72 hours; after 24 hours only one plus (+) reactions were seen.

Histological examination of positive patch test areas with Freon 11 and ethyl chloride were compatible with the clinical picture (acute eczema). The histological picture of the test site with ethyl chloride showed more dense infiltration of lymphocytes and more spongiosis than the area of positive reaction to Freon 11.

Case 3. Another female patient aged 29 was patch-tested because of a hand eczema. Testing with the standard series (I.C.D.R.G.)

showed only a weak reaction (+) to balsam of Peru. Because of the history of an itching eruption of the axillae after spraying with a deodorant, the battery of 11 deodorant sprays was tested. All eleven reactions were very positive (+++). In this case also a +++ reaction (after 48 and 72 hours) to ethyl chloride developed, but in contrast with the other patients, this patient also showed a ++ reaction to Freon 12. After 24 hours, all reactions were only weak (+) but these became stronger after 48 and 72 hours.

The histological picture of the positive test areas with Freon 12 and ethyl chloride were compatible with the clinical picture of acute eczema; there was no clear difference between the histological picture of the reactions to Freon 12 and ethyl chloride. In this case we tried to obtain positive reactions with open patch tests to Freon 11, Freon 12 and ethyl chloride. After 24 hours, a large area of the back showed an eczematous eruption especially around the test site which was sprayed with ethyl chloride and less around the Freon 11 and 12 areas.

Results

The results of patch testing with the two Freons and ethyl chloride are summarized in Table 1.

In three patients with a history of allergic reaction after using deodorant sprays, the patch test with Freon 11 (trichloromonofluoromethane) showed a positive allergic reaction after 48 and 72 hours; one patient

also reacted to Freon 12. All reactions were much stronger compared with those after 24 hours. In all three cases, the results of histological examination of the Freon positive test sites were compatible with the clinical picture of an acute eczema; the first patient showed a severe eczematous reaction far beyond the Freon 11 positive test area, which was treated by ethyl chloride in order to make a punch biopsy. Patients 2 and 3 were patch-tested with ethyl chloride resulting in strongly positive reactions; histological examination was again compatible with the diagnosis of acute eczema. It must be stressed that all histological slides did not show any signs of a toxic dermatitis.

Open patch tests (patient 3) with Freon 11 and 12 and ethyl chloride showed severe eczematous eruptions around the sprayed areas. None of the 15 control persons showed any kind of positive reaction either to the Freons or to ethyl chloride after 24, 48 and 72 hours.

Discussion

The chemical and physical properties of propellants are reviewed by Harry (*Cosmetology* 1973). In this book, the following types of propellants are discussed:

- Liquified gas propellants (Freon 11, 12, 114)
- Compressed gas propellants (nitrous oxide, carbon dioxide, nitrogen and sometimes argon)
- Mixed propellants (mixtures of 1 and 2, sometimes with methylene chloride and 2, 1, 1-trichloroethane)

Table 1. Patch test reactions to Freons 11 and 12 and ethyl chloride

	Freon 11			Freon 12			Ethyl Chloride		
	24,	48,	72 h	24,	48,	72 h	24,	48,	72 h
Patient 1	+	+++	+++	-	-	-	Not done		
Patient 2	+	+++	+++	-	-	-	+	+++	+++
Patient 3	+	++	++	+	++	++	+	+++	+++

Table 2. From Harry's *Cosmeticology*, sixth edition, p. 751

Propellant	International Code No.	Chemical Formula	Molecular Weight	Boiling Point	Vapour Pressure at 21°C psig
Dichlorodifluoromethane	12	C Cl ₂ F ₂	120.9	-29.8°C	70.4
Trichloromonofluoromethane	11	C Cl ₃ F	137.4	-23.8°C	13.4
Dichlorotetrafluoroethane	114	C Cl ₂ F ₄	170.9	+ 3.6°C	12.9

d. Hydrocarbon propellants (propane, n-butane and isobutane)

e. Gelled propellants.

For technical reasons, liquified gas propellants are used in most deodorant sprays. In this investigation only Freon 11, Freon 12 or a mixture of both were used. In other sprays Freon 114 is also added. Some details are given in Table 2.

The important feature of these Freons is that internal pressure remains constant; when the space in the pressure pack increases, more of the liquid propellant evaporates to maintain the same pressure. The pressure, however, depends on the temperature of usage: at elevated temperatures the development of high pressure causes an increased volatility of the spray. Because of this high volatility, which varies during different climatological conditions, it is impossible to determine exactly the quantity of the tested Freons.

The risks of getting an allergic skin reaction from propellants such as Freon 11 and 12 seem to be very small. It is far more likely that irritating factors of propellants such as the intensity of spraying, the distance from the body, and the cooling are responsible for the complaints of patients regularly using deodorant sprays. Because of the high and sometimes variable volatility it is impossible to determine what quantity has an irritant effect. For these reasons, the value of a random test asking the patient about discomfort from using deodorant sprays is very poor: only clear cases of eczema

of the axillae may be caused by allergy to one or more compounds of deodorant sprays. Nevertheless, in the three patients investigated it is clear that allergic reactions from propellants do occur.

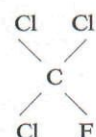
There is strong evidence that these reactions are indeed allergic: the eczema in these patients has to be regarded as allergic contact eczema. By allergological examination, clearly positive reactions were seen, being much stronger after 48 and 72 hours than after 24 hours. These findings are in contrast with the results after patch testing with primary toxic materials. In addition, the histological appearances of all sections was that of the picture of acute allergic eczema; the spongiosis and lymphocytic infiltration are not the findings of a primary toxic dermatitis.

In cases of sensitization to Freons it is necessary to warn the patients against using any spray.

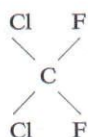
The eczematous reaction after ethyl chloride had been used (patient 1) and the strongly positive reactions to ethyl chloride (patients 2 and 3) are strong arguments that allergy for ethyl chloride may occur. Again, the histological appearance was that of acute allergic eczema. In taking biopsies, dermatologists must be aware of the possibility of an eczematous reaction to the use of ethyl chloride.

That sensitization to Freons must be rare can be explained by the fact that most propellants are extremely volatile. It is interesting to note that Freon 12 (dichlorodifluo-

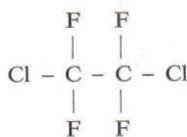
Table 3. Structural formulae of Freons 11, 12, 114 and ethyl chloride



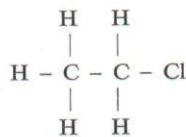
Freon 11



Freon 12



Freon 114



Ethyl chloride

romethane) is more volatile than Freon 11 (trichloromonofluoromethane). In all three patients this fact may be responsible for the positive reactions to Freon 11 and the two negative ones to Freon 12. Freon 114 (dichlorotetrafluoroethane) was not investigated because the sprays did not contain this material. Considering the possibility of group sensitization it has to be expected that cross-reactions to the Freons 11, 12 and 114 may occur on the basis of their structural formulae (see Table 3). It is questionable whether the sensitization of patients 2 and 3 to ethyl chloride may be explained as an expression of group sensitization. In contrast with the Freons, ethyl chloride contains only one halogen (see Table 3). It is probable that entirely halogenated chemicals like the Freons are more sensitizing than non- or scarcely halogenated compounds like ethyl chloride. In the case of DNCB, Rostenberg and Kanof (1945) demonstrated the loss of sensitizing capacity of m-dinitrobenzene, in which compound the chlorine atom is missing: chlorine atoms are easily split from the aromatic ring and linked to protein, while m-dinitrobenzene is incapable of such linkage.

More investigations, however, with chemically related materials are necessary to find

an answer to the problem of group sensitivity in these sprays.

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Address:
W. G. van Ketel
Department of Dermatology
Free University Hospital
Amsterdam
The Netherlands

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