Allergic contact dermatitis from formaldehyde in a liquid soap

ALEXANDER ZEMTSOV, MD; JAMES S. TAYLOR, MD; PHYLLIS EVEY, RN; JACOB DIJKSTRA, MD

■ A case is reported of a 74-year-old white man who developed generalized allergic contact dermatitis from formaldehyde present in a liquid soap. The patient had a 2+ positive patch test reaction to formaldehyde, which was present as a preservative in the soap at 0.1% concentration. His dermatitis cleared when he switched to a nonformaldehyde-containing bar soap. The cause of the contact dermatitis was covert to both physician and patient before patch testing. Since registration with the Food and Drug Administration of formaldehyde-containing soaps is voluntary, it is likely that there are more soaps on the market than the six registered as of June 1988.

□INDEX TERMS: FORMALDEHYDE, ADVERSE EFFECT; DERMATITIS, CONTACT; SOAPS □CLEVE CLIN J MED 1990; 57:301–303

ALLERGIC contact dermatitis to formaldehyde is well recognized.[1–3] In 1980 the North American Contact Dermatitis Group (NACDG) reported a skin sensitization incidence of 5% (124 reactors) among 2,374 patients patch tested with 2% formaldehyde in aqueous solution (NACDG, unpublished data, 1980); in 1984 and 1985 an incidence of 6.1% (70 reactors) was found among 1,144 patients.[4] Similar results were obtained in Europe.[5]

Formaldehyde is widely used in cosmetics and personal hygiene products as a bactericidal preservative. We report the case of a patient in whom allergic contact dermatitis developed from the use of a liquid soap that contained formaldehyde as a preservative. This is the first literature report of contact allergy to formaldehyde in a soap.

From the Department of Dermatology, The Cleveland Clinic Foundation.

Address reprint requests to A.Z., Department of Dermatology, The Cleveland Clinic Foundation, One Clinic Center, 9500 Euclid Avenue, Cleveland, Ohio 44195.

CASE REPORT

A 74-year-old, white man presented to the Department of Dermatology in March 1988 with acute eczematoid dermatitis of 2 weeks' duration on his hands, face, neck, and lower extremities. Allergic contact dermatitis was strongly suspected. The patient was given a prescription for amcinonide ointment and referred to the patch test clinic. Despite topical corticosteroid application, the condition continued to flare.

The patient stated that the skin eruption had started on his hands and then spread to his face, neck, and lower extremities. He could not identify any aggravating factors. He denied using any new cologne, moisturizing lotion, shampoo, or other personal hygiene products. His dermatologic history was significant only for the presence of hand dermatitis 15 years previously when employed as a factory worker; the condition completely resolved after his retirement 10 years previously. The patient had mild hay fever, but no asthma or childhood eczema and no family history of atopy.

His medical history was significant for adult-onset diabetes mellitus and atherosclerotic heart disease. His

medications were aspirin, isosorbide dinitrate, diltiazem, and tolbutamide, which he had been taking for many years. He had no known drug or food allergies.

Physical examination showed diffuse, erythematous, scaly, slightly crusting, pruritic papules most prominent on the hands, trunk, lower extremities, and neck.

He was patch tested with the standard screening tray of the American Academy of Dermatology[6] and vehicle tray. Standard patch testing procedures were employed using Finn Chambers (on Scanpore) as the patch test unit.[7] At 72 hours, the patient showed a strong +2 reaction to a 2% aqueous solution of formaldehyde.[1] Initially the relevance of this reaction to the patient's skin problem was unclear and he was asked to bring in all his personal hygiene products. On examination, we found that the liquid soap he used on his hands, face, scalp, trunk, and extremities contained formalin. He recalled purchasing the soap sometime before the dermatitis developed.

The liquid soap manufacturer informed us that this product contains 0.1% formalin by weight. We also tested the soap with formaldehyde detector solution (Fast Formalert, Organon Teknika Inc., Durham, N.C.) with a strongly positive result. During follow-up, the patient remained free of dermatitis after switching to a bar soap.

DISCUSSION

Formaldehyde is a colorless, flammable gas. Commercially, it is supplied as a 30% to 56% (by weight) aqueous solution known as formalin.[3,8] Each year, 9 billion pounds of formaldehyde are produced in the United States, and its presence in modern society is truly ubiquitous. To list a few sources in addition to cosmetics: pesticides, pharmaceutical manufacturing, printing, insulation, plastic molding, textiles, and tissue preservation.[3,8] However, the amount of formaldehyde present in most household items such as newspapers, books, and clothing is so low that it generally does not elicit allergic contact dermatitis in most formaldehyde-sensitive individuals.

Persons who are highly allergic to formaldehyde, such as one patient described by Fisher,[1] may have difficulty in a contemporary society. Most sensitized people can tolerate products containing formaldehyde at up to 30 ppm;[9] with increasing concentrations, a higher frequency of responders is seen.[10] The concentration of formaldehyde in our patient's liquid soap was at least 300 ppm. This calculation was based on the fact that 0.1% by weight is equal to 1000 ppm. Since formalin solution is 30% to 56% formaldehyde by weight, the formalin concentration in our patient's soap was 300 to 560 ppm.

Soaps of themselves are not sensitizers, but allergenic compounds may be added during formulation; these include germicides (such as formaldehyde), perfumes, lanolin, and colophony.[2] There may be a few reasons why formaldehyde contact allergy to soap has not been reported before. In 1981, according to US Food and Drug Administration data, only 5 of 148 commercial cosmetic products categorized as "bath soaps and detergents" contained formaldehyde, and in only one of those 5 products was the formaldehyde or formalin concentration above 0.1% (frequently, a concentration of formaldehyde reported to FDA is actually the formalin concentration.)[8] As of June 1988, six products containing formaldehyde in the category of "soaps and detergents" were registered with the FDA (personal communication, Heinz J. Eiermann, FDA, Washington DC, 1988). However, the FDA registration program for cosmetic product ingredients is voluntary, and the liquid soap to which our patient was allergic was not on the FDA list. Therefore, it is likely that more formaldehyde-containing soaps may be available in the United States.

The dose of formaldehyde needed to elicit an allergic response depends on temperature, occlusion, contact time, vehicle, and skin penetration (skin penetration of formaldehyde varies from one person to another and from one skin site to another). Wash-off products such as soaps and shampoo have a short contact time with skin and, even though formaldehyde is used in hundreds of shampoos at concentrations above 0.1%, formaldehyde contact dermatitis to shampoo is infrequent.[11]

Compared to bar soap, liquid soap has a relatively high concentration of glycerin, which is mixed with various amphoteric surfactants and detergents (personal communication from Dr. Richard Scott, Neutrogena Corporation Research and Development Division, July 1989). Glycerin by itself exhibits antimicrobial properties, so liquid soaps are probably no more susceptible than bar soaps to bacterial colonization.[1] Since soap is applied to skin more often than shampoo, soap containing formaldehyde may have greater potential to induce sensitization than formaldehyde-containing shampoos.

REFERENCES

1. Fisher AA. Contact Dermatitis. Philadelphia, Lea & Febiger, 3rd ed, 1986, pp 26, 250, 570–581.
2. Cromin E. Contact Dermatitis. Edinburgh, Churchill Livingstone, 1980, pp 788–795, 815.
3. Feinman SE. Formaldehyde Sensitivity and Toxicity. Boca Raton, CRC Press, 1988, pp 4, 17–37, 69–79.
4. Storrs FJ, Rosenthal LE, Adams RM, et al. Prevalence and relevance of

allergic reactions in patients patch-tested in North America—1984 to 1985. J Am Acad Dermatol 1989; **20:**1038–1045.
5. Agathos M. Formaldehyde contact allergy. Contact Dermatitis 1982; **8:**79–80.
6. Patch Testing in Allergic Contact Dermatitis. 7th ed. Evanston, Illinois, American Academy of Dermatology, 1984.
7. Rook A, Wilkinson DS, Ebling FJG, Champion RH, Burton JL. Textbook of Dermatology. 4th ed. Oxford, Blackwell Scientific Publications, 1986, p 516.
8. Final report on the safety assessment of formaldehyde. J Am Coll Toxicol 1984; **3:**157–184.
9. Jordan WP Jr, Sherman WT, King SE. Threshold responses in formaldehyde-sensitive subjects. J Am Acad Dermatol 1979; **1:**44–48.
10. Marzulli FN, Maibach HI. The use of graded concentrations in studying skin sensitizers: experimental contact sensitization in man. Food Cosmet Toxicol 1974; **12:**219–227.
11. Bruynzeel DP, van Ketel WG, de Haan P. Formaldehyde contact sensitivity and the use of shampoos. Contact Dermatitis 1984; **10:**179–180.