

# CONTACT POINTS

CONTACT DERMATITIS 2009; 60: 50–63

COPYRIGHT © BLACKWELL MUNKSGAARD 2008

ALL RIGHTS RESERVED

CONTRIBUTIONS TO THIS SECTION WILL NOT UNDERGO PEER REVIEW, BUT WILL BE REVIEWED BY THE EDITOR

## Occupational airborne allergic contact dermatitis in a concrete repair worker

*Contact Dermatitis* 2009; 60: 50–51

Johannes Geier<sup>1</sup>, Holger Lessmann<sup>1</sup> and Silke Reinecke<sup>2</sup>

<sup>1</sup>Information Network of Departments of Dermatology (IVDK), Department of Dermatology, University of Göttingen, 37075 Göttingen, Germany, and <sup>2</sup>Dermatological practice, 37603 Holzminden, Germany

**Key words:** 1,6-hexanediol diglycidyl ether; 2,4,6-tris(dimethyl aminomethyl)phenol; concrete repair; m-xylene diamine; occupational airborne allergic contact dermatitis; (Z)-N-9-octadecenylpropane-1,3-diamine.

Contact allergy to components of epoxy resin systems is an ongoing problem in the construction industry. Cases of airborne allergic contact dermatitis due to epoxy resins have been reported. Mostly, these patients are not only sensitized to the resin but also to hardeners and/or reactive diluents. Few potentially allergenic components of epoxy resin systems are commercially available as a patch test substance. Hence, by patch testing with the available epoxy resin series only, allergens responsible in the individual case might be missed (1, 2).

### Case Report

A 31-year-old bricklayer had been working in his job for 13 years without any skin problems. In April 2006, he started working in a company specialized in concrete repair of bridges where he was exposed to epoxy resin systems every day. He worked almost exclusively with three special products. In spite of adequate and allegedly sufficient personal protection equipment (protective suit, goggles, face mask, and nitrile gloves), a dermatitis of the forearms, in the region proximal to the gloves' edges, developed after 3 months. During the next 3 months, face eczema developed,

which was diagnosed as a work-related airborne dermatitis. In October 2006, he presented with an acute dermatitis with erythema, infiltration, and vesicles of the forearms and the face, marked over the periorbital region. Patch testing was performed according to International Contact Dermatitis Research Group guidelines with the baseline series, epoxy resin series, methacrylate series, and benzyl alcohol (all allergens from Hermal, Reinbek, Germany and applied on the back for 2 D using Finn Chambers® on Scanpor). The patient reacted to epoxy resin based on diglycidyl ether of bisphenol A (DGEBA resin), phenylglycidyl ether (PGE), 1,6-hexanediol diglycidyl ether (1,6-HDDGE), 1,4-butanediol diglycidyl ether (1,4-BDDGE), and bisphenol A diglycidyl methacrylate (BIS-GMA). Patch tests with isophorone diamine (IPDA) and benzyl alcohol remained negative (Table 1).

The patient returned to his job but stopped working with epoxy resins. However, airborne exposure was unavoidable because his colleagues at the construction sites continued working with epoxy resin products. Hence, his airborne dermatitis relapsed, and in the course of the following months, the episodes of dermatitis increased in frequency and intensity. Eventually, in November 2007, he stopped working in the construction industry, and the dermatitis resolved within a few weeks. In April 2008, we performed an additional patch test including three substances kindly supplied by the producer of the epoxy resin systems with which the patient had worked. Occlusion time was 1 D because of patch testing with non-standardized allergen preparations. He reacted to m-xylene diamine (MXDA), 2,4,6-tris(dimethyl aminomethyl)phenol (tris-DMP), and (Z)-N-9-octadecenylpropane-1,3-diamine (Table 1). Unfortunately, no control patch tests could be performed.

### Discussion

This case demonstrates some important features of contact allergy to

components of epoxy resin systems. Firstly, some individuals, probably with a special susceptibility, become sensitized very quickly, in this case after 3 months of exposure only, in spite of appropriate personal protection. Secondly, airborne dermatitis due to epoxy resins may not only develop in industrial settings with assumed high indoor airborne concentrations but also in open air exposure at construction sites. Thirdly, although sensitizations to the resins, which are the most important allergens, and several allergenic hardeners and reactive diluents can be detected by patch testing with the recently improved commercially available epoxy resin series, this may not always be sufficient.

Our patient was allergic to several components of the epoxy resin systems to which he was occupationally exposed, i.e. DGEBA resin, 1,6-HDDGE, MXDA, tris-DMP, and (Z)-N-9-octadecenylpropane-1,3-diamine. In the study, 'EPOX 2002', 1,6-HDDGE, and MXDA were the most frequent allergens among the reactive diluents and hardeners, respectively (2). Reactions to tris-DMP were not observed in 'EPOX 2002' when tested at 0.25% pet. In the present case, we tested tris-DMP at 1% pet. because reports in the literature suggested that higher test concentrations were adequate, and cases of contact allergy to tris-DMP were detected by patch testing this hardener at 0.5 or 1% pet. (3, 4). We could not find any reports of contact allergy to (Z)-N-9-octadecenylpropane-1,3-diamine (Fig. 1) in the literature. Analogously to other amine hardeners, we chose a test concentration of 0.5% pet., which elicited a strong vesicular patch test reaction. Although we could not perform any patch tests in controls, we regard this reaction allergic, and not irritant, due to the relatively low test concentration.

In addition to the substances mentioned, our patient also reacted to other chemical compounds that were part of the series tested in 2006. These were PGE, BIS-GMA, and 1,4-BDDGE.

Table 1. Patch test results (reactions at D3; scoring according to International Contact Dermatitis Research Group guidelines)

| Compound/patch test substance<br>(abbreviation; synonyms)                      | CAS no.    | Test<br>concentration*<br>(%) | Producer | Patch test,<br>October 2006 | Patch test,<br>April 2008 |
|--------------------------------------------------------------------------------|------------|-------------------------------|----------|-----------------------------|---------------------------|
| Components of the occupationally used epoxy resins products                    |            |                               |          |                             |                           |
| Epoxy resin based on diglycidyl ether<br>of bisphenol A (DGEBA resin)          | 25068-38-6 | 1                             | H        | ++                          | NT                        |
| 1,6-hexanediol diglycidyl ether [1,6-HDDGE;<br>1,6-bis(2,3-epoxypropoxy)hexan] | 16096-31-4 | 0.25                          | H        | ++                          | NT                        |
| Isophorone diamine (IPDA; 3-aminomethyl-<br>3,5,5-trimethylcyclohexylamine)    | 2855-13-2  | 0.5                           | H        | Negative                    | NT                        |
| (Z)-N-9-octadecenylpropane-1,3-diamine<br>(N-oley-1,3-propylene diamine)       | 7173-62-8  | 0.5                           | I        | NT                          | +++                       |
| 2,4,6-tris(dimethyl aminomethyl)phenol<br>(tris-DMP)                           | 90-72-2    | 1.0                           | I        | NT                          | ++                        |
| m-xylene diamine [MXDA; m-xylylene diamine;<br>m-phenylenebis(methylamine)]    | 1477-55-0  | 0.1                           | C        | NT                          | ++                        |
| Tetraethylene pentamine<br>(TEPA; 3,6,9-triazaundecan-1,11-diamine)            | 112-57-2   | 0.5                           | I        | NT                          | Negative                  |
| Trimethylhexane-1,6-diamine<br>(mixture of isomers)                            | 25620-58-0 | 0.5                           | H        | NT                          | Negative                  |
| Benzyl alcohol                                                                 | 100-51-6   | 1.0                           | H        | Negative                    | NT                        |
| Substances tested positive as part of commercially available test series       |            |                               |          |                             |                           |
| 1,4-butanediol diglycidyl ether (1,4-BDDGE)                                    | 2425-79-8  | 0.25                          | H        | ++                          | NT                        |
| Phenylglycidyl ether (PGE)                                                     | 122-60-1   | 0.25                          | H        | ++                          | NT                        |
| Bisphenol A diglycidyl methacrylate<br>(BIS-GMA)                               | 1565-94-2  | 2.0                           | H        | ++                          | NT                        |

++, erythema, infiltration vesicles; +++, erythema, infiltration, coalescent vesicles; C, Chemotechnique, Vellinge, Sweden; H, Hermal, Reinbek, Germany; I, in house preparation; NT, not tested.

\*All preparations in pet.

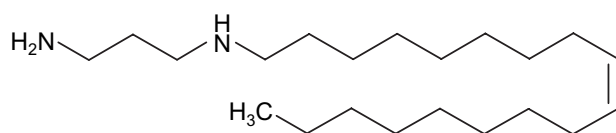


Fig. 1. Chemical structure of (Z)-N-9-octadecenylpropane-1,3-diamine.

We have demonstrated immunological cross reactivity between DGEBA resin and PGE by elicitation of an allergic reaction to PGE in animals experimentally sensitized to DGEBA resin (5). As recently described, we feel that concomitant reactions to DGEBA resin and BIS-GMA are also caused by immunological cross reactivity (6). This case supports our view, as the patient had no known contact to BIS-GMA. 1,4-BDDGE and 1,6-HDDGE are structurally very similar, and in 'EPOX 2002', concordance of allergic reactions to both these reactive diluents was very high (2). Hence, with these substances, immunological cross reactivity seems to be the most probable explanation, although this mechanism is not proven in animal experiments.

Regarding the spectrum of sensitization, this case underlines the necessity of patch testing with components

of a patient's own products, although the diagnosis seemed to be clear by testing with commercially available patch test series. Sensitization to tris-DMP would have been overlooked without extensive additional diagnostics. The same applies to the probable sensitization to (Z)-N-9-octadecenylpropane-1,3-diamine, which, to our knowledge, is described here for the first time.

## References

1. Pontén A Epoxy resin systems. In: *Contact Dermatitis*, 4th edition, Frosch P J, Menné T, Lepoittevin J -P (eds): Berlin Heidelberg, Springer, 2006: pp. 595–599.
2. Geier J, Lessmann H, Hillen U et al. An attempt to improve diagnostics of contact allergy due to epoxy resin systems. First results of the multicentre

study EPOX 2002. *Contact Dermatitis* 2004; 51: 263–272.

3. Brooke R, Beck M H. Contact allergy to 2,4,6-tris(dimethylaminomethyl)phenol. *Contact Dermatitis* 1998; 38: 284–285.
4. Kanerva L, Jolanki R, Estlander T. Allergic contact dermatitis from epoxy resin hardeners. *Am J Contact Dermat* 1991; 2: 88–97.
5. Pontén A, Zimerson E, Bruze M. Sensitizing capacity and cross-reactivity of phenyl glycidyl ether. *Contact Dermatitis* 2004; 50: 166.
6. Geier J, Lessmann H, Uter W, Schnuch A. Are concomitant patch test reactions to epoxy resin and BIS-GMA indicative of cross reactivity? *Contact Dermatitis* 2007; 57: 376–380. Addendum in: *Contact Dermatitis* 2008; 58: 319.

Address:  
Johannes Geier  
Information Network of Departments of  
Dermatology (IVDK)  
Department of Dermatology  
University of Göttingen  
von-Siebold-Str. 3  
37075 Göttingen  
Germany  
Tel: +49 (0)551 39 89 84  
Fax: +49 (0)551 39 60 95  
e-mail: jgeier@ivdk.org