

Sensitivity to epoxy resins and triethylenetetramine

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The present studies concerned 31 work sites in eight factories at which 422 persons were employed. In the course of seven years there were 126 cases of dermatitis, 99 of whom were patch-tested. Positive reactions to epoxy resin and/or to triethylenetetramine were found in 65.7 % of the subjects. The aetiology of the other cases is discussed. Some of the patients who were positive to epoxy resin were tested with Bisphenol A and modified resins with blocked epoxy groups. The latency period of dermatitis and the localization were recorded, as well as the influence of the season and of certain working conditions on the occurrence of sensitization. Of the 80 patients who changed their occupation, there were relapses in 50 within one year. Relapses were more frequent in persons who continued to work with epoxy resins for more than three months after the appearance of dermatitis and in those simultaneously sensitive to allergens in the standard series.

Key words: atopy in epoxy dermatitis – barrier creams – Bisphenol A – change of occupation – epoxy group – epoxy resins – latency period of epoxy dermatitis – protective gloves – triethylenetetramine.

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Sensitivity to epoxy resins and triethylenetetramine (TET) is the most frequent cause of occupational dermatitis in Warsaw. This may be explained by the lack of automation of the production methods in some establishments (Rudzki & Krajewska 1973). For this reason, a relatively large group of subjects sensitive to these contactants was found.

Material and Methods

The observations concerned workers employed at 31 work sites in factories known to one of us (D.K.) from daily medical practice over a period of seven years. At these work sites, 828 persons were employed during the period under review, 422 working at any one time. In the course of seven years there were 126 cases of dermatitis, 99 of

whom were tested. All the patients had contact with epoxy resin and only two had no contact with TET.

The patients were patch-tested with:

1. Epidian 5 (Polish epoxy resin, molecular weight about 150) 1 % in acetone
2. Triethylenetetramine (TET) 1 % in water
3. Epidian 3 (epoxy resin, molecular weight about 500) 1 % in acetone
4. Epidian 1 (epoxy resin, molecular weight about 900) 1 % in acetone
5. Standard test series.

Some of the patients were also tested with:

- A. Poliol (1 % in acetone) – a resin obtained by pressure hydrolysis with water in a weak acid medium of Epi-

dian 5. During this process the epoxy groups are blocked. The preparation is described in patent claim No. 174046 of 12th September, 1974

- B. A resin obtained by esterification of Epidian 5 with acetic acid according to routine methods (1 % in acetone)
- C. Bisphenol A (2 % in water).

Results

Among the 99 subjects tested, 48.4 % were positive to Epidian 5; 55.1 % were positive to TET; and 34.3 % were negative to both. Among those positive to Epidian 5 and/or TET, 20 were positive to one or more substances of the standard series. All the workers came in contact with organic solvents, and at many work sites they were also in contact with other hardening agents and glycidyl ethers.

Tests on patients positive to Epidian 5 with epoxy resins of different molecular weight showed that positive reactions are less frequent with resins of higher molecular weight (Table 1). Modified resins did not elicit reactions in most subjects weakly sensitive to Epidian 5 (Table 2). Among the 78 persons positive to Epidian 5, 13 were positive to Bisphenol A.

In subjects positive only to Epidian 5, the mean period between starting work and the occurrence of dermatitis was 21.5 months; in those positive to TET it was 18.5 months; and in those positive to both these contactants it was 7.7 months. In all the 99 patients

tested, the first signs appeared mainly on the hands (56 persons), less frequently hands and face (33 persons), the face only (9 persons) and rarely the thighs (1 person). In subjects sensitive to TET, the face was involved only a little more frequently compared with involvement in persons sensitive to Epidian 5.

Of the persons sensitive to Epidian 5 and/or TET, 34 % gave a family history of allergy. Among the 312 healthy workers employed at the same work sites the percentage of persons with allergic relations was 28.5. Persons with a family history of allergy did not differ from the remaining patients in the latency period of dermatitis. In nearly half the patients exacerbations were noted in summer.

Sensitivity to Epidian 5 and/or to TET was not less frequent in persons using barrier creams, protective gloves or clothes or taking a shower after work. In the present investigations comparisons were made between:

- (a) patients and healthy subjects at the same work sites
- (b) patients and workers employed at work sites where, in spite of contact with epoxy resins, dermatitis did not occur.

Sensitization was largely proportional to the annual turnover of epoxy resins and TET used at particular work sites.

Table 1. Patch tests with epoxy resins of various molecular weights in 50 patients positive to Epidian 5

Substance	Number Positive	% Positive
Epidian 3	42	84
Epidian 1	35	70

Table 2. Patch tests with modified epoxy resin preparations in patients positive to Epidian 5

Substance		Patients Positive to Epidian 5	
		Positive	Strong Positive
Poliol	positive	1	6
	negative	11	0
Esterified Epidian 5	positive	1	6
	negative	11	0

The 80 patients who changed their occupation were followed up for at least one year. Relapses of dermatitis of variable intensity occurred in 50 of the patients. It is noteworthy that relapses occurred more frequently (in 73 %) if the patients continued work for more than three months after the appearance of dermatitis than if they changed their employment within the first three months (42.8 %). Relapses were noted in all six workers who were also found to be sensitive to chromium; but it was only slightly more frequent in those sensitive to other allergens of the standard series compared with that in subjects negative to the latter allergens. A family history of allergy showed no relation to the frequency of relapses.

Discussion

The aetiology of dermatitis in the 99 tested subjects was complex. The largest group (65.7 %) was positive to Epidian 5 and/or TET. It is interesting that in the case of sensitivity to both these contactants the latency period of dermatitis is much shorter than when the sensitivity is directed to epoxy resin or TET only. Within this group, however, some were positive to the standard series allergens, to other hardeners and/or to glycidyl ethers. It is possible that contact with organic solvents may have been one of the causes of dermatitis, at least in some patients. The remaining 34.3 % of patients may be divided into three groups:

1. positive to other hardeners and/or glycidyl ethers
2. positive only to allergens of the standard series
3. negative to all contactants tested, probably cases of irritant dermatitis.

Sensitivity to other hardeners and/or glycidyl ethers will be the subject of another report.

The possibility was taken into account that Bisphenol A is a determinant of sensitivity to epoxy resins (Gaul 1960, Fregert & Rorsman 1962). Among our patients, 16.6 % of those positive to Epidian 5 were also positive to Bisphenol A. The strong irritant effect made testing with epichlorhydrin impossible. However, the role of the epoxy group in sensitization to epoxy resins is supported by the fact that, after blocking of this group, the test became negative in a large proportion of the weakly sensitive subjects. It is not clear why patients strongly positive to Epidian 5 reacted to modified resins. Perhaps irritant reactions occurred or additional antigen determinants were responsible.

The negative observations as regards the preventive action of barrier creams were most unexpected. They are, however, in keeping with *in vitro* investigations on some other creams (Wahlberg 1972) and the comparisons quoted in the literature on the incidence of contact dermatitis in the Rolls Royce Works during periods when creams were used or not used (Crow 1969).

The relapses of contact dermatitis in patients positive to Epidian 5 only and/or TET after change of occupation is difficult to explain. But, apart from the present patients, some others have been observed in whom dermatitis persisted for several years after ceasing work with epoxy resins, and who were negative to all other substances tested.

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