

Routine patch testing with cadmium chloride

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During a 22-month period, 2.0 % cadmium chloride in distilled water was included in our routine patch test series. Twenty-five of 1502 eczema patients showed reactions (1.7 %), but none had any relevant history. At serial dilution test only one patient reacted to 1.0 % cadmium; all the other dilutions applied gave negative reactions. Analysis by atomic absorption spectrophotometry of the cadmium chloride used for patch testing showed that it contained less than 1 $\mu\text{g/g}$ of chromium, copper, cobalt and nickel. The conclusion is that no certain case of contact allergy to cadmium chloride has been revealed. An experimental study using the guinea pig maximization test is in progress.

Key words: Atomic absorption spectrophotometry – cadmium chloride – contact allergy – patch testing – serial dilution tests.

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In industry, exposure to cadmium may cause kidney and lung diseases; cadmium is also suspected to be a carcinogen (Friberg et al. 1974).

Borelli (1965) found that 1.01 % of 6798 German workers were patch test positive to 2 % cadmium sulphate (Table I). The frequency was 2.7 % in workers with manifest allergy ("manifesten Allergien"), 1.3 % in patients with other skin diseases ("sonstige Hautkrankheiten"), and in 0.75 % there was no relevant history ("ohne Anamnese"). In other studies the frequency of positive reactions to cadmium varied between 0 and 3.5 % (Table I).

Since the toxicology of cadmium has been thoroughly studied in Sweden (Friberg et al. 1974), our Department of Occupational Dermatology sometimes gets questions about possible skin hazards from chronic cadmium exposure. For this reason it was decided to include cadmium chloride in our

routine patch test series in order to compare the situation in Sweden with results reported from other parts of Europe (Table I).

Material and Methods

During 22 months (Jan. 1975–Nov. 1976) 2.0 % cadmium chloride (Mallinckrodt analytical reagent, Lot RES) in distilled water (pH 6.3) was included in the routine patch test series together with about 30 well-known contact allergens. A total of 1502 eczema patients were tested during this period at our Department of Occupational Dermatology using A-I[®] test patches. The chloride was chosen since we have some quantitative data about its percutaneous absorption rate (Wahlberg 1973a).

Serial dilution test

The same method previously used for other

Table 1. Test reactions to cadmium reported in the literature

	Total number tested	% Positive	Concentration
Borelli 1965	6798	1.01	2.0 % CdSO ₄
Scarpa & Ferrea 1967	356	1.1	2.0 % CdSO ₄
Düngemann et al. 1972	356	3.5	2.0 % CdSO ₄
Fregert & Hjorth 1969	651	0	2.0 % CdCl ₂
Hegyi et al. 1974	248	1.2	2.0 % CdSO ₄
Wahlberg 1977	1502	1.7	2.0 % CdCl ₂

metal compounds was used (Skog & Wahlberg 1969, Wahlberg & Skog 1971, Wahlberg 1973b). Cadmium chloride was mixed with distilled water in the following concentrations: 1.0, 0.5, 0.25, 0.125 and 0.062 %.

Atomic absorption spectrophotometry

In order to evaluate if impurities of other metals (i.e. chromium, copper, cobalt or nickel) in the cadmium chloride used for patch testing contributed to the reactions, it

was analyzed by a Perkin-Elmer 303 atomic absorption spectrophotometer (Wahlberg et al. 1977).

Results

During the time period, 25 out of 1502 (1.7 %) tested eczema patients reacted to 2.0 % cadmium chloride (Table 2). The frequency was somewhat higher in men (2.1 %) than in women (1.4 %). In 17 cases +, in eight cases ++, but no vesicular reactions were recorded. In six cases it was possible to perform a serial dilution test (Table 3). Only one patient (no. 2) reacted down to 1.0 % cadmium chloride; all others were negative to all dilutions applied.

Of the 25 patients with positive reactions to cadmium, 8 were also positive to chromium, 4 to cobalt, 3 to nickel, 3 to mercury and 1 to copper.

Analysis by atomic absorption spectro-

Table 2. Patch test reactions to cadmium chloride

Total number tested	+	++	+++	% pos.
No.	No.	No.	No.	
♂ 632	8	5	0	2.1
♀ 870	9	3	0	1.4
Total: 1502	17	8	0	1.7

Table 3. Serial dilution tests with cadmium chloride

Patient No.	1	2	3	4	5	6
Sex	M	FM	FM	M	M	M
Age, years	59	41	25	68	24	36
CdCl ₂ conc. %	2.0	+	+	+	++	+
	1.0	+	—	—	—	—
	0.5	—	—	—	—	—
	0.06	—	—	—	—	—
Concomitant contact allergies for other metal compounds	Cr Co	Ni Cu	—	Hg	Ni	Cr

Table 4. Analysis of cadmium chloride by atomic absorption spectrophotometry

	$\mu\text{g/g}$
Cr	< 0.7
Cu	< 1.0
Co	< 0.4
Ni	< 1.0

photometry of the cadmium chloride used for patch testing showed that it contained less than 1 $\mu\text{g/g}$ of chromium, copper, cobalt and nickel (Table 4).

None of the patients had experienced any exposure to cadmium compounds. They denied exposure to oils and cutting fluids and none worked in plants where cadmium was prepared or handled.

The final clinical diagnoses in the 25 cases were: Allergic contact eczema (chromium, nickel, rubber, plastics, etc.) 7 cases, non-allergic contact eczema 5 cases, atopic eczema 2 cases, hypostatic eczema 1 case, mycosis fungoides 1 case and unclassified eczemas 9 cases.

Discussion

The frequency of positive reactions in this study was about the same that has been reported from Germany, CSSR and Italy (Table 1). On the other hand Fregert & Hjorth (1969) found no positive reactions. They also used cadmium chloride, but ethanol instead of water as vehicle.

The results from the serial dilution tests (Table 3) do not speak in favour of contact allergy since only one of six patients reacted down to 1.0 % cadmium chloride. The test reactions could not be explained by impurities of other metal contact allergens in the test substances employed (Table 4). None of the 25 patients that reacted to cadmium at the routine patch testing had experienced any exposure to the metal or

its compounds. Döngemann et al. (1972) reported that cadmium allergy could be acquired from contact with cutting fluids, but such exposure was denied by my patients.

The conclusion is that no conclusive case of contact allergy to cadmium has been found in this study. In order to elucidate further the possible sensitizing properties of cadmium, we have started an experimental study using the guinea pig maximization test of Magnusson & Kligman (1970).

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