

The additive value of patch testing with patients' own products at an occupational dermatology clinic

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Background and objectives: Patch testing with commercially available kits detects only 70–80% of relevant allergens in patients with contact dermatitis. This is not ideal, especially when occupational issues are being evaluated. This study analyses our data regarding reactions to patients' own products.

Methods: In a 5-year period, 1532 patients were assessed in our occupational dermatology clinic.

Results: We found that 101 patients (6.6%) reacted to their own samples. In 20 (1.3%) cases, reacting to their own samples was the only clue for detecting the responsible allergen. In 59 (3.9%) cases, testing with their own samples reinforced their reactions to commercial allergens.

Conclusions: We found the overall additive value of testing with patients' own products to be 5.2%. This is not a low proportion considering the 20–30% false negative rate when patch testing. Patch testing with patients' own samples, appropriately diluted should be undertaken whenever possible.

Key words: allergic contact dermatitis; allergy; hand eczema; irritant contact dermatitis; own substances; samples. © John Wiley & Sons A/S, 2009.

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Patch testing is an *in vivo* provocation test. When performed and interpreted properly, its sensitivity and specificity is estimated to be 70–80% (1, 2). Occupational skin disease is reported to comprise 12–30% (3, 4) of the occupational health burden and is associated with significant impact on the economy, work productivity and absenteeism and quality of life. Contact dermatitis accounts for 90–95% of occupational skin disease (4). Therefore, patch testing by an experienced physician is of crucial importance. In many cases, in spite of patch testing with commercially available patch test series, the responsible allergen remains elusive unless testing with patients' own products is undertaken. The aim of this retrospective study was to quantify the additive value of testing with patients' own material in the setting of an occupational dermatology clinic.

Materials and Methods

Study population

The study included 1532 consecutively patch tested patients with suspected occupational contact dermatitis, who were referred for evaluation at the occupational dermatology clinic at the Skin and Cancer Foundation, Melbourne, Australia during the period of 1999–2004.

Patch test procedure

All patients were tested to an extended European baseline series and commercially available relevant series (Chemotechnique Diagnostics®, Malmö, Sweden). All of their series were available and were used case relevantly. Patients were instructed to

bring their own substances and products from work to the clinic including chemicals, hand cleansers, and their personal protective equipment. Closed patch tests were performed using appropriately diluted products (5) according to their chemical ingredients and information from their Material Safety Data Sheets. Patches were applied in Finn chambers® on Scanpor® (Epitest, Tuusula, Finland). Readings were performed on D2 and D4.

Relevance and data interpretation

Relevance was defined as a temporal and clinical relationship between the use of the product and the outbreak of the dermatitis, and an improvement of the rash when contact with the allergen was discontinued. Criteria for work relatedness were based on modified Mathias criteria (6, 7). Relevance was scored as: relevant, past relevant irrelevant and unknown. Patients were divided into four groups according to their reactions:

- (1) Patients who reacted to both commercial allergen and their own samples.
- (2) No reactions to either commercial allergen or their own products.
- (3) Patients who reacted to commercial allergens only.
- (4) Patients who reacted to own samples only.

The additive value of testing with patients' own material was scored as: (i) no additive value and (ii) definite additive value in cases where a reaction to their own materials was the only clue to diagnosis and patients in whom a positive reaction to the patients' own products reinforced the result of the positive reaction to the commercial series. For most cases, controls were patch tested to the same materials. No additive value group includes patients in whom reactions to their own products were considered not to be relevant to their current dermatitis.

We divided the patients into 12 different occupational groups (Table 1).

Statistical analysis

All analyses were conducted using the STATA (version 9; STATA Corporation, TX, USA) statistical package. Differences of proportions between subjects were assessed with χ^2 tests. Fisher's exact tests were used when one or more expected values were less than 5. $P < 0.05$ was considered as statistically significant. Because of too small numbers in some occupational groups, they were merged into the following categories: healthcare, machine operators, and tradesmen and miscellaneous.

Results

About 101 patients reacted to their own products (6.6%). For 20 of them (1.3% of the total), testing with their own products had definite additive value. For 59 (3.9%), testing with their own products reinforced the reaction to the commercial allergens. For 22 patients (1.4%), reactions to their own products were considered not to be relevant to their current dermatitis.

These patients had a total of 111 reactions to the commercial allergens. Of them, 86 (77.4%) were to European baseline series allergens and 90 (81.1%) were to our extended baseline series.

Table 1 shows the general characteristic of the study group. The majority were male (71%), with an average age of 40. Tradesmen were the most common occupational group, followed by machine operators and healthcare workers.

There was no difference between genders in the additive value of testing patients to their own samples (Table 2, $P = 0.89$). There was an overall difference in the additive value of testing patients to their own samples in the different occupational groups ($P = 0.017$). Machine operators had the most additive value of testing to their own samples (38.9%) compared with the other occupational groups. Tradesmen had the most reinforcement of their reaction to a commercial allergen by testing to their own samples (70.3%) compared with the other occupational groups. Healthcare workers had the least additive value of testing to their own samples. The difference between tradesmen and healthcare workers regarding tendency to react to own product was significant ($P = 0.02$).

The most common reactions were to epoxy resin (24.7%) followed by thiuram mix (16.9%) and colophonium (13.0%). Of those that reacted to colophonium, 50% were tradesmen. The majority of those who reacted to epoxy resin were also

Table 1. General characteristics of the study group

Characteristics	N (%)
Gender	
Males	72 (71.3%)
Females	29 (28.7%)
Age	40.4 ± 12.5
Occupation	
Healthcare	14 (13.9)
Science	4 (4.0)
Hair & beauty	6 (5.9)
Food handlers	4 (4.0)
Machine operators	18 (17.8)
Process packers	3 (3.0)
Production managers	4 (4.0)
Tradesmen	37 (36.6)
Farming	2 (2.0)
Cleaner	1 (1.0)
Clerical	3 (3.0)
Miscellaneous	5 (5.0)

Table 2. Comparison of added value of subjects own allergens by subject characteristics

	No additive value N (%)	Definite additive value N (%)	Reinforced result N (%)	p-value
Total	22 (21.8)	20 (19.8)	59 (58.4)	
Gender—male	15 (20.8)	15 (20.8)	42 (58.3)	
—female	7 (24.1)	5 (17.2)	17 (58.6)	0.89
Age (Mean $\pm$ SD)	41.4 $\pm$ 12.8	41.6 $\pm$ 11.7	39.7 $\pm$ 12.7	
Occupation				
Healthcare <i>n</i> = 14	7 (50.0)	1 (7.1)	6 (42.9)	
Machine operators <i>n</i> = 18	5 (27.8)	7 (38.9)	6 (33.3)	
Tradesmen <i>n</i> = 37	5 (13.5)	6 (16.2)	26 (70.3)	
Miscellaneous <i>n</i> = 32	5 (15.6)	6 (18.8)	21 (65.6)	0.017

Table 3. Patients in whom reactions to their products yielded definite additive value

Age	Sex	Occupation	Own material	Controls (tested/ positive)
53	M	Tradesmen	Adhesive	5/0
34	F	Healthcare	Disinfectant	5/0
37	M	Machine operator	Cooling fluid	5/0
67	M	Tradesmen	Adhesive	5/0
36	M	Clerical	Adhesive	5/0
37	M	Machine operator	Cutting oil	5/0
32	F	Process packer	Rubber handle	0
38	M	Machine operator	Cutting oil	5/0
50	M	Tradesmen	Ink	0
60	M	Machine operator	Cooling fluid	5/0
57	M	Machine operator	Metal device	3/0
30	F	Hair and beauty	Glove	0
30	M	Tradesmen	Food additive	5/0
28	M	Machine operator	Cutting oil	3/0
38	M	Miscellaneous	Plant	5/0
31	M	Miscellaneous	Plant	5/0
59	M	Tradesmen	Food additive	3/0
42	F	Tradesmen	Surface coating	0
37	F	Hair and beauty	Glove	0
36	M	Machine operator	Disinfectant	5/0

tradesmen (84.2%). For thiuram mix, 30% were healthcare workers and 15% were tradesmen.

Tables 3 and 4 summarize the data regarding the definite and reinforced additive value groups.

Discussion

Patch testing with commercially available trays is the diagnostic gold standard in allergic contact dermatitis. A large number of chemicals have commercial applications and about 3700 chemicals are reported allergens (5). Workers may be exposed to newly synthesized chemicals. Not all of them are appropriately listed in Material Safety Data Sheets (8). Sensitization to a substance is not always detected when the ingredients are tested separately. The contact allergen may be a contaminant or an intermediate product (9). A new allergen might also be formed during storage, resulting in compound allergy. Although limited in the number of allergens available, commercially available patch test series have been demonstrated to detect 70–80% of

responsible allergens (1, 2). However, 20–30% of cases would remain undiagnosed unless additional testing is performed.

Patch testing with patients' workplace substances often helps to confirm the causative allergen, even in cases where potential individual allergens have been tested separately. Testing with own materials may also assist to prove causality in medico-legal cases.

The aim of this study was to quantify the additive value of testing with workers' own material. Several studies have been conducted previously in order to evaluate this value; to our knowledge, this is the first that has been conducted in an occupational dermatology clinic.

In a German study of the IVDK network (10), the data of 2460 patients were evaluated. Of them, 208 (8.5%) reacted to their own materials. In 44% of these cases (1.7% of the total), only the patients' own products were tested positive and were considered to be relevant. In a subsequent analysis of recent IVDK data (11), 8.6% had a positive reaction to their leave-on cosmetic products and 5.3% reacted to the wash-off products. In about one-third of the patients reacting to their own products, further tests to commercial allergens were negative.

In a Danish study (12), 2.6% of the patients had one or more positive reactions to their own cosmetic products. Of them, 40% did not react to any of the commercial available allergens.

In other studies, the rate of reactions to own products was reported to be 3.2–11.6% (13–15).

In our cohort, 101 patients reacted to their own products (6.6%) and 79 patients benefited from testing to their own samples (5.2%). For 20 of them, a reaction to their own products was the only clue to diagnosis, leading to identification of the cause of their occupational contact dermatitis. These rates are similar to previous reports. The majority (58.4%) of reactions to patients' own samples reinforced positive reactions to the commercial allergens, assisting the practitioner in the establishment of the diagnosis. Of the patients, 77.4% reacted to at least one of the European baseline series. The same percentage would have reacted to Chemotechnique's baseline series and Panel 1

Table 4. Patients in whom reactions to their products reinforced the reaction to the commercial allergens

Age	Sex	Occupation	Own material	Positive commercial allergens
57	M	Tradesmen	Adhesive	Epoxy resin; colophonium
52	M	Tradesmen	Adhesive	Epoxy resin
53	M	Tradesmen	Resin	Epoxy resin
35	F	Tradesmen	Adhesive	Epoxy resin
19	M	Tradesmen	Resin	Epoxy resin; p-phenylenediamine
42	F	Tradesmen	Resin	Epoxy resin
44	M	Tradesmen	Adhesive	Epoxy resin
56	M	Tradesmen	Adhesive	Epoxy resin
47	M	Tradesmen	Adhesive	Epoxy resin
58	M	Tradesmen	Adhesive	Epoxy resin
59	M	Tradesmen	Resin	Epoxy resin
43	M	Tradesmen	Resin	Epoxy resin
26	M	Tradesmen	Resin	Epoxy resin
44	M	Tradesmen	Resin	Epoxy resin
23	M	Tradesmen	Resin	Epoxy resin
23	M	Tradesmen	Resin	Diethylenetriamine
52	M	Tradesmen	Resin	Colophonium
58	M	Tradesmen	Melamine resin	Formaldehyde
28	M	Tradesmen	Insulation	Colophonium
33	M	Tradesmen	Resin	Colophonium; potassium dichromate
51	M	Tradesmen	Adhesive	Colophonium
49	M	Tradesmen	Cooling fluid	Chlorocresol
49	M	Tradesmen	Disinfectant	Benzalkonium chloride; Budesonide
43	M	Tradesmen	Metal	Cobalt chloride; potassium dichromate
26	F	Tradesmen	Liquid soap	Fragrance
56	F	Tradesmen	Glove	Thiuram mix
39	M	Machine operator	Resin	Epoxy resin
28	M	Machine operator	Cooling fluid	Formaldehyde; diazolidinyl urea
26	M	Machine operator	Cooling fluid	Formaldehyde
59	F	Machine operator	Cooling fluid	Chloroacetamide
61	M	Machine operator	Liquid soap	Formaldehyde; coconut diethanolamide
28	F	Machine operator	Sock	Basic Red 46
49	M	Production manager	Resin	Epoxy resin
52	M	Production manager	Glue	Colophonium
45	M	Production manager	Glue	Colophonium
51	F	Process packer	Glove	Thiuram mix; nickel sulphate
29	F	Hair and beauty	Adhesive	Hydroxylethyl methacrylate
25	F	Hair and beauty	Permanent formulation	Glyceryl monothioglycolate
24	F	Hair and beauty	Hair dye	p-Phenylenediamine
24	F	Hair and beauty	Adhesive	Hydroxylethyl methacrylate
23	F	Hair and beauty	Wax	Colophonium
36	M	Healthcare	Dental filling	Methyl methacrylate
37	F	Healthcare	Glove	Thiuram mix
29	F	Healthcare	Glove	Thiuram mix
35	F	Healthcare	Liquid soap	coconut diethanolamide
36	M	Healthcare	Hand cream	Formaldehyde; DMDM hydantoin; Quaternium-15
35	F	Healthcare	Hand cream	Quaternium-15
17	M	Science	Liquid soap	Coconut diethanolamide
43	M	Science	Glove	Thiuram mix
19	M	Science	Resin	Colophonium
29	F	Food handler	Spice	Fragrance
37	M	Food handler	Spice	<i>Myroxylon pereirae</i> ; Fragrance
36	M	Food handler	Glove	Thiuram mix
63	F	Cleaner	Glove	Thiuram mix
33	M	Farming	Plant	Sesquiterpene lactone mix
51	M	Farming	Glove	Thiuram mix
42	M	Clerical	Rubber thimble	Thiuram mix
48	M	Clerical	Uniforms	Mercapto mix
25	M	Miscellaneous	Leather	Potassium dichromate

and 2 of TRUE Test™ (Allerderm, Phoenix, AZ, USA), demonstrating the high concordance of the methods as was shown in previous studies (16–18). Testing our extended baseline series (adding diazolidinyl urea, imidazolidinyl urea, black rubber mix, ethylenediamine, tosylamide/formaldehyde resin, and propylene glycol) yielded additional 3.7%

relevant reactions. Testing patients' substances used at work is a valuable supplement to the use of commercially available series as it reflects the actual exposures in the workplace. Furthermore, it assists in detecting reactions to rare allergens or these produced by additive or synergistic actions of several ingredients (19).

We found a greater trend for machine operators and tradesmen to react to their own products, probably as a result of exposure to a wide variety of allergens.

In conclusion, we found the additive value of testing with patients' own material to be 5.2%. Although a modest proportion, all of these reactions were relevant, and an additive value of 5.2% in a test with 70–80% sensitivity is not to be underestimated.

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