

Original article

Results of standard series patch testing in patients with occupational allergic contact dermatitis

Background: In the workplace, the skin is at high risk of exposure to chemicals and other contaminants, and occupational dermatitis is an important field of study.

Methods: We evaluated 230 patients referred to our clinic because they were affected by dermatitis suspected to be of occupational and allergic origin. They were tested with the allergens of the GIRDCA standard series, and with supplementary series when indicated.

Results: Among the 230 subjects, 49 were positive only to supplementary series (26.3% of all allergic contact dermatitis), while 130 (69.9% of all allergic contact dermatitis) were considered to have an occupational allergic contact dermatitis diagnosed by the standard series alone. The most frequent occupations of the patients were health care workers and hairdressers/beauticians. The most common agents responsible for occupational allergic contact dermatitis were metals and para-phenylenediamine.

Conclusions: As the standard series detected a relatively low proportion of occupational allergic contact dermatitis, it is not adequate to recognize an occupational allergic contact dermatitis, certain supplementary series should also be tested. However, even if such occupational series are used, we remain likely to continue to underestimate the frequency of occupational allergic contact dermatitis, because workers come into contact with a large number of substances that are often unknown.

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In the workplace, the skin is at high risk of exposure to chemicals and other contaminants, and occupational dermatitis is an important field of study (1). Contact dermatitis is the most frequent form (2). In this paper, we assess the usefulness of patch testing with the GIRDCA (Italian Group of Research in Environmental and Contact Dermatitis) standard series in the diagnosis of occupational allergic contact dermatitis (OACD).

Patients and Methods

Study group

In the present study we evaluated 230 consecutive patients [47 males (20.4%) and 183 females (79.6%) with a mean age of 38.4 years (range 13–75)], referred to the Section of Allergology of Bari Polyclinic, Bari, Italy, between 1 January 1998 and 31 May 2001. They all had dermatitis suspected to be of occupational origin and were patch tested on the basis of clinical and anamnestic data as indicated by a dermatologist.

Patch testing

All patients were tested with the allergens of the GIRDCA standard series, using Finn Chambers (Epitest, Tuusula, Finland).

Additional allergens were tested when indicated. The patch tests were applied on each subject's back using Scanpor tape (Norges-plaster, Vennesla, Norway) and removed after 2 days. Readings were taken on day 2 (D2) and D4. The reactions were evaluated according to International Contact Dermatitis Research Group recommendations (3). Doubtful or irritant reactions were considered negative. On completion of readings on D4, each positive result was assessed in relation to the patient's occupation and clinical history. Individual cases were judged to be occupational or nonoccupational according to criteria previously reported (4). In this report, however, housewives' dermatitis has not been included as occupational.

Statistical methods

The statistical analysis included chi-square test and Fisher's exact test (one-tailed). In all instances, a $P > 0.05$ was considered to be statistically significant. The analysis of the standard series in relation to the occupation was carried out for those occupations that comprised of more than 10 subjects. The analysis of the standard series in relation to causative allergens was carried out for those allergens that were positive in more than 10 patients. The analysis of the standard series in relation to localization, occupation and allergen was carried out for the most common sensitizers among the most common occupations, in order to find the most significant results.

Table 1. Occupations of patients diagnosed as having occupational allergic contact dermatitis by the GIRDCA standard series alone among 230 subjects

Occupation	No. tested (%)	No. positive patch tests (%)*
Health care worker	62 (27)	39 (62.9)
Hairdresser or beautician	44 (19.1)	34 (77.3)
Construction worker	35 (15.2)	18 (51.4)
Food service worker	24 (10.4)	16 (66.7)
Metalworker or mechanic	16 (7)	4 (25)
Teacher or student	13 (5.7)	4 (30.8)
Office worker	11 (4.9)	5 (45.4)
Farmer or florist	7 (3)	3 (42.8)
Textile worker	4 (1.7)	2 (50)
Leather worker	4 (1.7)	2 (50)
Shop assistant	4 (1.7)	2 (50)
Graphic work (printing and photography)	3 (1.3)	0
Pharmacist and herbalist	3 (1.3)	1 (33.3)
Total	230	130

* Percentage in relation to the number of individuals employed in each occupation in our series.

Results

Among the 230 subjects, 130 [20 males (15.4%) and 110 females (84.6%)] showed at least one positive reaction to an allergen of the standard series alone that was relevant to their job; 56 subjects [23 males (41.1%) and 33 females (58.9%)] showed at least one positive reaction to an allergen of supplementary series: 49 were only positive to supplementary series, while seven were positive to both standard and supplementary series.

Among patients with patch test positivity to the standard series alone, 83 (63.8%) were positive to one allergen, and two or more positive reactions were observed in 36.2% (47/130), 27.7% (36/130) had two, 6.9% (9/130) three and 1.5% (2/130) four positive reactions. However, not all the positive patch tests to the standard series found in patients with occupational allergic contact dermatitis were relevant to the current occupational problem. Some were relevant to past episodes of allergic contact dermatitis, some were related to current nonoccupational exposure and some represented a cross-reaction between different allergens.

The occupational groups examined and the patch test results are shown in Tables 1 and 2. Table 3 features a detailed list of the causative allergens of the standard series relative to each occupation group and the localization of the dermatitis. The most frequent occupations were health care workers and hairdressers/beauticians, the standard series identified the highest number of occupational allergic contact dermatitis cases among hairdressers/beauticians (77.3%, $P < 0.05$). The most common agents responsible for occupational allergic contact dermatitis were metals [97/177, (54.8%)] and para-phenylenediamine [29/177, (16.4%)].

Table 2. Positive patch test reactions in 130 subjects with occupational allergic contact dermatitis diagnosed by the standard series alone

Allergen (%)	No. positive reactions (%)
Nickel sulphate (5)	67 (51.5)
Para-phenylenediamine (PPD) (1)	29 (22.3)
Cobalt chloride (1)	20 (15.4)
Potassium dichromate (0.5)	10 (7.7)
4,4 Diaminodiphenylmethane (DDM) (0.5)	8 (6.1)
IPPD (0.1)	7 (5.4)
Epoxy resin (1)	6 (4.6)
Thimerosal (0.1)	5 (3.9)
Fragrance mix (8)	5 (3.9)
Methylchloroisothiazolinone methylisothiazolinone (aqueous) (0.01)	3 (2.3)
Thiuram mix (1)	3 (2.3)
Formaldehyde (aqueous) (1)	3 (2.3)
Primin (0.01)	2 (1.5)
Neomycin sulphate (20)	2 (1.5)
Mercapto mix (1)	2 (1.5)
Myroxylon Pereirae resin (balsam of Peru) (25)	1 (0.8)
Mercuric chloride (1)	1 (0.8)
Colophonium (20)	1 (0.8)
Lanolin alcohol (30)	1 (0.8)
Sesquiterpene lactone mix (0.1)	1 (0.8)
p-Tert-butylphenol-formaldehyde (PTPF) resin (1)	0
Disperse yellow 3 (1)	0
Clioquinol (5)	0
Mercaptobenzothiazole (2)	0
Disperse red 1 (1)	0
Benzocaine (5)	0
Paraben mix (16)	0
Quaternium-15 (1)	0
Imidazolidinyl urea (2)	0

All substances in petrolatum unless stated otherwise.

Hairdressers were most frequently sensitized to para-phenylenediamine [24/41, (58.5%)], whereas dichromate was the most frequent occupational allergen for construction workers [7/21, (33.3%)] (in all cases, $P < 0.05$).

A significant association was found among hairdressers between sensitization to para-phenylenediamine and hand dermatitis [21/24, (87.5%)] ($P < 0.05$).

Discussion

Our results show that 80.9% (186/230) of the subjects tested had allergic contact dermatitis of occupational origin: 69.9% (130/186) of dermatitis was diagnosed by standard series alone, while 26.3% (49/186) was diagnosed only by supplementary series. A previous study (5) claimed that a standard series, although not identical to ours, was adequate to recognize an occupational allergic contact dermatitis. In practice, only in a few cases did the authors decide to integrate the standard series with other substances specific to a particular work situation.

Table 3. Main characteristics of patients with occupational allergic contact dermatitis diagnosed by the standard series

Occupation (no. patients) (%)	Relevant allergens (no. patients)	Localization of eczema (no. patients)
Healthcare worker (39) (30)	Nickel sulphate (26); cobalt chloride (6); thimerosal (4); MCI/MI (3); p-phenylenediamine (3); fragrance mix (2); potassium dichromate (2); 4,4 diaminodiphenylmethane (2); myroxylon pereirae resin (1); IPPD (2); neomycin sulphate (2); formaldehyde (1); mercuric chloride (1); lanolin alcohol (1); mercapto mix (1)	Face (5); neck (3); trunk (3); hands (31); wrists (5); forearms (4); legs (1); generalized (1)
Hairdresser or beautician (34) (26.2)	p-Phenylenediamine (24); nickel sulphate (15); cobalt chloride (5); fragrance mix (3); 4,4 diaminodiphenylmethane (3); formaldehyde (1); colophonium (1)	Face (3); neck (3); trunk (1); hands (32); wrists (4); legs (2); generalized (2)
Construction worker (18) (13.9)	Potassium dichromate (7); epoxy resin (5); nickel sulphate (4); cobalt chloride (2); 4,4 diaminodiphenylmethane (1); IPPD (2); thiuram mix (1)	Face (1); trunk (1); hands (11); wrists (1); forearms (3); legs (2); generalized (3)
Food service worker (16) (12.3)	Nickel sulphate (9); cobalt chloride (3); thiuram mix (2); p-phenylenediamine (1); potassium dichromate (1); formaldehyde (1); IPPD (1)	Face (1); hands (11); wrists (3); forearms (3); generalized (1)
Office worker (5) (3.8)	Nickel sulphate (2); IPPD (2); p-phenylenediamine (1); 4,4 diaminodiphenylmethane (1); mercapto mix (1); cobalt chloride (1)	Face (1); neck (2); hands (3); wrists (2)
Teacher or student (4) (3.1)	Nickel sulphate (4); cobalt chloride (1)	Trunk (1); hands (4); wrists (2); generalized (1)
Metalworker or mechanic (4) (3.1)	Nickel sulphate (3); cobalt chloride (1)	Hands (2); wrists (1); forearms (1)
Farmer or florist (3) (2.3)	Primin (2); sesquiterpene lactone mix (1)	Face (1); hands (2); forearms (1)
Textile worker (2) (1.5)	Nickel sulphate (2)	Neck (1); forearms (1)
Leather worker (2) (1.5)	Nickel sulphate (1); epoxin resin (1)	Face (1); hands (1)
Shop assistant (2) (1.5)	Nickel sulphate (1); cobalt chloride (1); 4,4 diaminodiphenylmethane (1)	Face (1); hands (2)
Pharmacist and herbalist (1) (0.8)	Thimerosal (1)	Hands (1)
Total 130 (100)		

In our study, the relatively low frequency of occupational allergic contact dermatitis detected by standard series may be attributable to several factors:

1. Specific substances (e.g. drugs, herbs) not included in standard series can be responsible for occupational allergic contact dermatitis. In practice, the standard series identified the highest frequency of occupational allergic contact dermatitis among, e.g. food handlers, because several of the allergens in the standard series are commonly present in such work environments.
2. There was a high frequency of irritant contact dermatitis among wet workers, many of whom were misdiagnosed at the time of the clinical examination.
3. Determination as to whether an allergic contact dermatitis is caused by the working or by the leisure environment is frequently difficult using only a standard series, because the allergen responsible for the patch test positivity can be present in both. For example, nickel is the most frequent allergen responsible for both occupational and non-occupational dermatitis (6–11).
4. Finally, an important factor in contact allergy development seems to be the degree of exposure, in terms of concentration and duration. Therefore, even if substances included in the standard series are present in many, if not all, work environments, they will not be responsible for contact allergy unless other specific criteria are present.

In our study, dermatitis was localized predominantly on the hands, wrist and forearms. However, there were also other less common localizations, such as the face, neck, trunk and legs, and some cases of generalized dermatitis.

In some occupations, such as in construction workers, these localizations may be the result of airborne contact dermatitis. In other occupations, such as in hairdressers, these uncommon localizations are related to the features of the allergic contact dermatitis, namely, the initial reaction is at the site of contact, but numerous red papules may develop in other skin areas not exposed to the allergen, or may be widespread. In addition, generalized eczema can be induced by oral intake of contact allergens, such as metals, in sensitized individuals. In practice, all subjects with generalized eczema were sensitized to at least one such substance.

From an analysis of our data, it would be reasonable to conclude that standard series are suitable only as a screening test in the diagnosis of occupational allergic contact dermatitis, especially among workers who come into contact with special substances and materials. In these, certain supplementary series need to be tested. However, even if such occupational series are used, we likely continue to underestimate the frequency of occupational allergic contact dermatitis because workers come into contact with a large number of substances that are often unknown.

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