

Detection of occupational allergic contact dermatitis by patch testing

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Occupational allergic contact dermatitis (OACD) is an important medical and occupational health problem. If undiagnosed, the disease may persist and even spread widely, resulting in severe and permanent disability to the worker, who may be deprived of his legal right to compensation. OACD is not uncommon in China, although many dermatologists fail to establish the connection between disease and working conditions, because they think that the diagnosis of OACD is the work of occupational medicine and that special diagnostic methods are required. The Ministry of Health and Ministry of Labour and Social Security of China have issued a new law recently to emphasize the prevention and treatment of occupational disease. It requires physicians to make an accurate diagnosis and report of occupation-related diseases. In this study, we have successfully investigated 14 cases of OACD in our hospital by patch testing the patients with a standard series of allergens and investigating by questionnaire the suspected offending occupational allergens. During a 2-year period (2001–2003), 14 patients with suspected allergic contact dermatitis were investigated and confirmed as having OACD. OACD may develop in many different occupations. In this study, nickel, 4-phenylenediamine, fragrance mix, black rubber mix, colophonium, epoxy resin and thiuram mix were identified by patch testing as the main offending allergens in such patients. These results indicate that patch testing plays a vital role in the diagnosis and identification of occupational allergens, and our study shows that OACD can often be diagnosed by patch testing patients with a standard series. The clinician should be alert to recognize the offending allergens of OACD by referring to patch testing all patients with clinically suspected contact dermatitis, and then educating the sensitized worker in how to avoid further exposure to the causative allergens.

Key words: 4-phenylenediamine (PPD), airborne, allergic contact dermatitis, black rubber mix, colophonium, epoxy resin, fragrance mix, nickel, occupational, thiuram mix. © Blackwell Munksgaard, 2003.

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Occupational allergic contact dermatitis (OACD) is an important medical and occupational health problem. Occupational contact dermatitis (OCD) results from exposure of workers to an allergen or irritant found in the workplace that comes into direct or indirect contact with the skin. OCD may be irritant or allergic or both. It may also be in combination with an endogenous dermatitis such as atopic dermatitis. OACD commonly affects the hands, forearms and face in accordance with the common pattern of exposure.

Identification of the occupation-related allergen improves the primary, secondary and tertiary preventive strategies for OACD. These allergens may also be preventable contributing factors in the development and severity of non-occupational dermatitis. Diagnosis of OACD

requires a high index of suspicion and knowledge of the worker's environment. Final confirmation of the allergen requires identification by patch testing (1).

Identifying OACD is important; if undiagnosed, the disease may persist and even spread more widely, resulting in total and permanent disability to the worker, who may even be deprived of his legal right to compensation. The clinician should be alert to recognize OACD and educate patients about the probable dangers of occupational allergens. OACD is usually treatable and preventable, if properly and successfully diagnosed at an early stage.

Currently, OACD is not always investigated by most dermatologists in China. Many dermatologists fail to establish the connection between

the skin disease and working conditions. They think that the diagnosis of OACD is the work of occupational medicine and that special diagnostic methods are required. Patch testing is not always performed and its efficacy even questioned. Assessment of OACD has been undertaken instead by occupational medicine departments. The purpose of this study was to detect OACD by patch testing the patients with a standard series. The offending agents were then investigated by a questionnaire.

Patients and Methods

Patients

During a 2-year period (2001–2003), 14 patients with suspected allergic contact dermatitis were investigated in the Department of Dermatology, Peking University Third Hospital, and confirmed as OACD.

Patch testing

Patch testing was performed with a modified European standard series of allergens supplied by Chemotechnique Diagnostics, Malmö, Sweden (Table 1). Allergens were applied to the upper back using Finn Chambers[®] on Scanpor[®] tape (Epitest, Tuusula, Finland), and the results were recorded at day 2 and day 3 according to ICDRG recommendations (2).

Investigation of suspected offending occupational allergens by a questionnaire

After patch testing, a questionnaire study was performed to investigate the suspected offending agents by using a published questionnaire (3).

Results

The results of patch testing and the clinical manifestations of the 14 OACD patients are summarized in Table 2. Among these patients, only 4 out of 14 patients themselves suspected that their dermatitis was work-related, and none of these 4 suspected the right contact allergen.

Discussion

The overall prevalence of occupational skin disease in China is as yet unknown. Recently, the Ministry of Health and Ministry of Labour and Social Security of China have jointly announced a new law on occupational disease prevention and treatment to check the incidence of occupational diseases and guarantee the legal rights of workers in this regard. The law requires physicians to make an accurate diagnosis and report of occupation-related disease. Because it is a new field of dermatology in China, most of the dermatologists here do not yet know how to make an accurate diagnosis of OACD with the help of patch testing. We have conducted

Table 1. The standard patch test series of allergens

Allergen
Benzocaine
Black rubber mix (<i>N</i> -isopropyl- <i>N</i> -phenyl-4-phenylenediamine, IPPD; <i>N</i> -cyclohexyl- <i>N</i> -phenyl-4-phenylenediamine, CPPD; <i>N,N</i> -diphenyl-4-phenylenediamine, DPPD)
2-Bromo-2-nitropropane-1,3-diol (Bronopol)
Carba mix (1,3-diphenylguanidine, zinc diethyldithiocarbamate, ZDC; zinc dibutyl dithiocarbamate, ZBC)
Colophonium
Epoxy resin
Ethylenediamine dihydrochloride
Formaldehyde
Fragrance mix (cinnamic alcohol, hydroxycitronellal, amylcinnamal, geraniol, eugenol, isoeugenol, oakmoss absolute)
Imidazolidinyl urea
Mercapto mix (<i>N</i> -cyclohexylbenzothiazylsulfonamide, mercaptobenzothiazole, dibenzothiazyl disulfide, morpholinylmercaptobenzothiazole)
<i>N</i> -(Cyclohexylthio) phthalimide
Nickel sulfate
4-phenylenediamine base (PPD)
Parabens (methyl-4-hydroxybenzoate, ethyl-4-hydroxy benzoate, propyl-4-hydroxy benzoate, butyl-4-hydroxy benzoate)
Potassium dichromate
Sesquiterpene lactone mix (alantolactone, dehydrocostus lactone, costunolide)
Thiuram mix (tetramethylthiuram monosulfide, TMTM; tetramethylthiuram disulfide, TMTD; tetraethylthiuram disulfide, TETD; dipentamethylenethiuram disulfide; PTD)
Thimerosal (Merthiolate)
Tixocortol-21-pivalate

Table 2. The clinical features and results of patch testing in 14 occupational allergic contact dermatitis patients

Number	Sex/age (years)	Occupation (years)	Eczema duration (years)	Eczema distribution	Suspected allergens	Positive patch testing	Diagnosis
1	M/60	Metal working (40)	5	Hyperkeratotic lesions on back of hands	Gloves Metal	Black rubber mix Nickel sulfate	OACD from rubber and metal
2	M/21	Metal working (2)	1	Back of hands. Papules and vesicles on finger tips and sides of the fingers	Metal	Potassium dichromate Nickel sulfate	OACD from nickel
3	M/50	Metal working (8)	4	Erythema and papules on sides of the fingers	Metal fluids Metal	Nickel sulfate	OACD from metal
4	M/40	Metal working (2)	1	Hands, face, forearms, neck and chest	Metal	Potassium dichromate	Airborne OACD from nickel
5	M/30	Hairdressing (15)	13	Back of hands, palms and sides of the fingers.	Metal fluids Dyes Perfume	Nickel sulfate Potassium dichromate 4-phenylenediamine base Fragrance mix	OACD from hair dye, perfume
6	F/30	Hairdressing (8)	5	Papules on finger tips and side of the fingers	Metal Dyes Perfume	4-phenylenediamine base Colophonium	OACD from hair dye
7	M/20	Electrician (2)	1	Back of hands, tips and side of the fingers	Rubber Metal	Black-rubber mix	OACD from rubber
8	F/26	Electronics industry (6)	3	Both hands	Soldering fluxes Metals	Colophonium Nickel sulfate Thimerosal	OACD from Colophonium
9	M/36	Electronics industry (10)	2	Discoid lesions on hands	Metal Colophonium	Colophonium	OACD from colophonium
10	F/37	Electronics engineer (17)	10	Both hands	Metal Plastic	Nickel sulfate Fragrance mix	OACD from metal
11	M/40	Surgeon (14)	6	Back of hands and forearms	Gloves, disinfectants	Thiuram mix	OACD from rubber
12	F/40	Gymnastics teacher (18)	15	Hyperkeratotic lesions on palms. Erythema, papules on face, back of hands	Grip aid Metal Wood	Colophonium	Air borne OACD from colophonium
13	F/46	Chemist working with PPD (15)	5	Dried and scaly lesions on hands	PPD	4-phenylenediamine base	OACD from PPD
14	M/44	FRPD* working with epoxy resin (28)	1	Side of the fingers and back of hands.	Epoxy resin Dyes	Epoxy resin Potassium dichromate	OACD from epoxy resin

PPD = 4-phenylenediamine.

*FRPD = fibre-reinforced plastics designer.

this investigation to provide better health care to the patients and to establish a sound diagnostic procedure for instituting in occupational health programmes in China. We have diagnosed 14 patients with OACD in the present study.

OACD in metalworking is a frequent skin disease among metalworkers. People working with metals are at considerable risk of OACD. In our study, 4 out of 14 patients were metalworkers. In their daily routine work, they had been in continual contact with various kinds of metals for several years. They had developed their clinical symptoms of dermatitis after working for several years. All these patients showed positive reactions to nickel. Patient no. 4 also worked with metalworking fluids, which contained complex mixtures of chemicals. Many of these chemicals were irritant and sensitizing. The patient was also working in poorly ventilated spaces and had developed a dry cough as well as lesions on his face, neck and arms. The lesions improved significantly after using gloves and better ventilating the working environment, airborne OACD to nickel being diagnosed.

OACD is very common among hairdressers and beauticians. They make up a significant proportion of occupational cases in a patch-test clinic. Hairdressers have to do a great deal of wet work. Unprotected wet work and low working humidity are both risk factors for the development of OACD, particularly hand dermatitis. Studies have shown that nickel from scissors and other instruments is a frequently observed allergen in hairdressers. In our study, 2 out of 14 patients were hairdressers, and both such patients showed a positive reaction to *p*-phenylenediamine (PPD) in hair dyes. They had never dyed their own hair, but they frequently came into contact with the dyed hair of customers.

Electricians are also at risk of occupational skin disease from working with electric cables, copper and metallic tools. One patient in our study was an electrician and showed a positive reaction to black rubber mix.

The common allergens in the modern electronics industry are colophonium in soldering flux and insulating tape, chromate, nickel, cobalt, rubber and epoxy resins (4). 3 patients in our study were working in this industry. 1 such patient reacted to nickel, 1 to both nickel and colophonium and 1 to colophonium.

Hospital workers are also at significant risk of OACD. Such a patient in our study was a surgeon who showed a positive reaction to thiuram mix, containing common rubber allergens. Thiurams are components of rubber gloves, adhesives, certain pesticides and medication (1). Our study

discovered the exact allergen for this specific patient and protected him from losing his job. By using gloves without thiurams, he was able to continue his profession.

Teachers are also subject to OACD. In this report, such a patient was a teacher of gymnastics, rather different from the usual teacher. In this regard, her suspected allergens were the same as those of an athlete, namely rubber, metal, colophonium, etc. She always used the rosin of gymnasts on her hands. She developed eczematous lesions on her hands and the exposed skin of the face, neck and forearms. Airborne OACD from colophonium was diagnosed. Colophonium is commonly used by stringed-instrument players and baseball and bowls players. It is derived from several conifer species and is also present in cosmetics, adhesives, lacquers, varnishes, soldering fluxes, paper and many other industrial products (1).

One of the other 2 patients was a chemist who worked with PPD and other amines for 15 years and had had hand dermatitis for 5 years. She was found to be reactive to PPD on patch testing. The other patient was a fibre-reinforced plastics designer who worked with epoxy resin and dyes and was reactive to epoxy resin on patch testing.

In conclusion, occupational skin diseases are highly preventable, because they arise from man-made conditions and they can be prevented through alteration of those conditions. Evaluation of OACD includes identification of conditions of exposure and patch testing. Standard series patch testing plays a most important role in the diagnosis and identification of occupational allergens. Our study shows that OACD can often be diagnosed by patch testing with a standard series. Patch testing should be performed in all patients with clinically suspected hand dermatitis, and sensitized workers should avoid further exposure to the causative allergens.

Although we have successfully diagnosed 14 cases of OACD by patch testing the patients with a standard series, some OACD may be missed by patch testing only with a standard series. Rycroft (4) has stated that a standard series is rarely sufficient in occupational cases, and that its supplementation with additional series and the patient's own samples is frequently required.

It should be pointed out that many contact allergies are unsuspected before patch testing and that their relevance is only established retrospectively. In our study, only 4 out of 14 patients considered that their dermatitis was work-related, and none of these 4 turned out to have suspected the right contact allergen. It remains, therefore,

important to patch test with a standard series of allergens.

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