

Occupational allergic contact dermatitis caused by wood dusts

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Exposure to wood dusts may cause various skin and mucosal symptoms. Allergic dermatoses, caused by wood dusts, diagnosed at the Finnish Institute of Occupational Health during 1976–1999 are reported here. 16 had allergic contact dermatitis and, 2 had contact urticaria. 9 men (3 cabinet makers, 3 joiners, 1 carpenter, 1 knifemaker and 1 machinist) were mainly exposed to tropical hardwoods. 1 man had dermatitis caused by western red cedar. 5 patients, 3 men and 2 women, were exposed to Finnish pine or spruce dusts, and 1 man to aspen. 7 also had rhinitis, 4 asthma or dyspnoea and 3 conjunctivitis. On patch testing, 10 men reacted to 9 different wood dusts, including teak (5), palisander (3), jacaranda (2), mahogany (2), walnut (2) and obeche (1). Reactions to wood allergens, including lapachol (2), deoxylapachol (1), (R)-3,4-dimethoxydahlbergione (2), 2,6-dimethoxy-1,4-benzoquinone (1), mansonone A (2) and salicyl alcohol (1), were noted in 4 cases. All but 1 of 5 patients exposed to pine or spruce dusts reacted to the sawdusts, all 5 to colophonium, 3 to abietic acid, 2 to tall oil resin, 3 to wood tar mix and 4 to other wood gum resins. Of the 2 CU patients, 1 was prick and RAST positive to obeche, 1 reacted with urticarial dermatitis to punah wood dust on chamber exposure. Occupational allergic dermatoses are mainly caused by the dusts of hardwoods, mostly due to Type IV allergy, but may also be caused by softwood dusts. Patch tests can be done with wood dusts, but should be confirmed by patch testing with wood allergens if possible.

Key words: contact dermatitis; contact urticaria; series of plant allergens; padauk; punah; deoxylapachol; (R)-4-methoxydahlbergione; (R)-3,4-dimethoxydahlbergione; mansonone A; 2,6-dimethoxy-1,4-benzoquinone; occupational; wood dusts; respiratory effect; airborne. © Munksgaard, 2001.

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Dusts from tropical hardwoods can cause various skin and mucosal symptoms. Especially sawing, machining, sanding and turning of wood produce fine dust which may induce adverse effects to the skin and mucosa. Wood dusts can cause both Type I and Type IV allergy. In most cases, allergic contact dermatitis develops as a result of Type IV allergy. The sensitizers in hardwoods are usually benzo- and naphthoquinones (1–4).

Materials and Methods

Patients

We report 18 patients examined in 1976–99 at the Finnish Institute of Occupational Health (FIOH). All of these patients were diagnosed as having allergic contact dermatitis (ACD) or contact urticaria (CU) caused by wood dusts. 2 of the patients have previously been reported in detail (5, 6).

Examinations

Examinations consisted of anamnestic and exposure data and patch tests (Tables 1, 2) which were done as previously described (7). Prick tests and RASTs were also included in the examinations (8). In 1 case of urticaria, a chamber exposure test was done (9).

Patch tests were performed with the suspected wood dusts (Tables 1, 2) brought from the patients' workplaces, usually as such, moistened with water. In the case of missing samples, dusts obtained from an importer were used. Control tests were done with the same dusts in 5–20 non-exposed dermatological patients.

Patch tests also included a modified European standard series (Chemotechnique Diagnostics AB, Sweden) and other relevant series. Hausen's series of plant allergens (10) supplemented with salicyl alcohol (2-methylolphenol) contained in aspen

(*Populus tremula* L., fam. Salicaceae) bark (5) was applied to 5 patients (Table 1). In the case of pine (*Pinus sylvestris* L., fam. Pinaceae) and spruce (*Picea abies* Karsten, fam. Pinaceae), test substances contained, in addition to colophonium, other allergens of conifers (Table 2). Prick tests included a standard series (Allergologisk Laboratorium A/S, Denmark) and, according to the anamnestic data, prick tests with the same wood dusts as patch tests were done. In 4 cases determinations of total IgE and IgE-specific antibodies (RAST, radioallergosorbent test) were done, in 2 cases to obeche (wawa, *Triplochiton scleroxylon* K. Schum., fam. Sterculiaceae), in one case to padauk (padouk, *Pterocarpus* sp) and in 1 case to punah (*Tetramerista glabra* Miq., fam. Tetrameristaceae) dusts (11).

Results

Of the 18 patients, 16 had ACD (Tables 1 and 2) and 2 had CU. 9 of 16 patients had ACD caused by topical hardwood dusts, and 1 had dermatitis caused by western red cedar (*Thuja plicata* Donn ex D. Don, fam. Cupressaceae) (Table 1). The ACD of 5 patients was due to sawdusts from Finnish conifers (Table 2). In addition, 1 patient had ACD caused by Finnish aspen (Table 2). 2 had contact urticaria, caused by dust from punah and obeche woods, respectively.

6 of the patients sensitized to imported woods

were cabinetmakers, joiners or carpenters, whereas the others came from various occupations (Table 1). All patients were 38–58-year-old men, who had been working for a long time in their occupations. In the patch tests all showed positive reactions to the suspected wood dusts. 3 out of 5 patients tested with wood allergens gave positive reactions to 1 or more test substances (Table 1). All except 2 patients also had mucosal symptoms, mostly rhinitis, but also dyspnoea and asthma, itching of the eyes or conjunctivitis (Table 1).

3 men and 2 women, all in different occupations, had ACD from sawdust of pine or spruce (Table 2). They were 46–50 years old, except 2 men who were 19 and 20 years old. On patch testing, all, except the woodwork teacher, reacted to pine dust. All were positive to colophonium. Other results are shown in Table 2. 1 of the patients had asthma and 1 had conjunctivitis.

The 2 men who developed contact urticaria from wood dusts were a 30-year-old doormaker in a joinery plant and a 33-year-old salesman in a timber warehouse. The doormaker had been exposed to punah wood dust when sanding down doors made of the wood. He developed rhinitis, dyspnoea, conjunctivitis and extensive reddish dermatitis of short duration. Prick test, RAST and patch test to punah wood dust were all negative, but a chamber provocation test with the dust repeatedly elicited in 30 min a similar dermatitis. The salesman was exposed to obeche wood dust

Table 1. Occupational allergic contact dermatitis caused by imported woods ($n=10$) and positive (pos) patch test results with wood dusts and series of plant allergens at the Institute of Occupational Health in 1976–98

No.	Age (years)/sex	Occupation	Causative wood dust	Patch test wood dust	Series of plant allergens	Other symptoms
1.	58/M	knifemaker	teak	pos	not done	no
2.	38/M	cabinetmaker	teak	pos	not done	rhinitis, asthma
3.	44/M	stage joiner	teak	pos	not done	rhinitis, itching of eyes
4.	56/M	carpenter	teak	pos	deoxylapachol	rhinitis, conjunctivitis
			obeche		lapchol	
5.	38/M	cabinetmaker	palisander	pos	not done	dyspnoea
6.	46/M	machinist	palisander	pos	(R)-3,4-dimethoxy-dahlbergione	no
			(jacaranda?)		mansonone A	
			walnut	pos	not done	rhinitis
7.	51/M	cabinetmaker	palisander	pos		
			jacaranda	pos		
8.	45/M	joiner	mahogany	pos	negative	rhinitis (padouk)
			(Honduras)			
9.	54/M	joiner	mahogany	pos	(R)-3,4-dimethoxy-dahlbergione	rhinitis, conjunctivitis
			(Honduras)		mansonone A	
			sapele	pos	2,6-dimethoxy-1,6-benzoquinone	
			Rio palisander	pos		
			(jacaranda?)			
			teak	pos		
			koto	pos		
			walnut	pos		
10.	45/M	organmaker	western red cedar	pos	negative	rhinitis, asthma

Table 2. Occupational allergic contact dermatitis caused by Finnish wood dusts ($n=6$) and positive patch test results of wood dusts and allergens at The Finnish Institute of Occupational Health in 1977–99

No.	Age/years sex	Occupation	Causative wood dust	Positive patch test		Other symptoms
				wood	allergen	
11.	19/M	woodworker	pine	pine	colophonium *wood tar mix	no
12.	46/F	sawworker	pine	pine	colophonium	no
13.	50/F	glueworker	pine	pine	colophonium abietic acid wood tar mix ***pine gum resin	asthma
14.	46/M	woodwork teacher	pine	no	colophonium abietic acid wood tar mix tall oil resin pine gum resin ***spruce gum resin **Terebinthina laricis	conjunctivitis
15.	21/M	sawer	spruce pine	no pine	colophonium abietic acid tall oil resin pine gum resin	no
16.	38/M	farmer	aspen	aspen bark aspen	salicyl alcohol (2-methylol phenol)	no

* Wood tar mix=mixture of pine, beech, juniper and birch tars.

** Terebinthina laricis=Venice turpentine.

*** From living trees.

when sawing the wood, which induced rhinitis, asthma and CU. A prick test to obeche wood dust was positive, as well as an obeche RAST (class 3). He was also diagnosed as having occupationally induced rhinitis and asthma from obeche dust.

Discussion

There are numerous sensitizing wood species, but an occupationally induced ACD due to wood dusts is relatively rare (3–4, 12–13). The largest number of cases has been reported from St John's Institute of Dermatology, London, where 80 patients with ACD were diagnosed: 78 of these cases were occupationally induced (1).

Occupationally-induced ACD from wood dusts is not common in Finland. During 1990–96, 24 (0.9%) out of 2647 cases of ACD, and 6 (0.5%) out of 1205 cases of CU or protein contact dermatitis (PCD) reported to the Register of Occupational Diseases were caused by wood species (14). 10 of the 16 ACD patients diagnosed at the FIOH had ACD due to imported woods, mainly tropical woods (Table 1), as observed in previous reports (1–4). Almost $\frac{1}{3}$ of these cases had been diagnosed at the FIOH in 1990–1996. The ACD of 5 patients was caused by sawdusts of Finnish conifers, and 2 of these cases were diagnosed during 1990–96.

Identification of the wood species is essential in establishing the diagnosis and in giving adequate advice to persons sensitized to wood dusts. Espe-

cially the identification of imported woods may be troublesome, because the timbers usually come through different countries and distributors to the final destination, and the same trade name can refer to different wood species (3). In this study, the information on wood species is based on the information obtained from workplaces and importers, and no further attempts were made to confirm the botanical identity of the woods.

In line with previous reports, teak caused most of the allergic reactions (1, 6, 12). In 2 cases the sensitization was also confirmed by positive patch tests to 2 allergens of teak, deoxylapachol and lapachol (15). Palisander caused 3 and jacaranda 2 positive patch test reactions. *Dahlbergia latifolia* Roxb., fam. Leguminosae, wood has been called palisander, and *Dahlbergia nigra* Allem.ex Benth., fam Leguminosae, has been called jacaranda, also called Rio palisander (4, 16). A quinonoid compound (R)-4-methoxydahlbergione (2, 3, 16) has been isolated from both wood species. Santos Palisander (Santos rosewood, pao ferro, *Machaerium scleroxylon* Tul., fam. Leguminosae) has been used as a substitute for palisander which contains (R)-3,4-dimethoxydahlbergione (1, 17). 2 of the patients, a machinist preparing gunstocks (Table 1, patient no. 6) and a joiner making wooden interiors from various hardwood species (Table 1, Patient no. 9) for ocean cruisers, gave positive patch test reactions to (R)-3,4-dimethoxydahlbergione and mansonone A. Mansonone A is also a

sensitizing quinone compound isolated from mansonia tree, also called bété (*Mansonia altissima* A. Chev., fam. Sterculiaceae) (2, 3). It is possible that these 2 men had also been exposed to Santos palisander, leading to allergy to (R)-3,4-dimethoxydahlbergione (13, 16–19) from contact with this substitute for true palisander. They had also handled walnut, but not mansonia wood. They may, however, have been in contact with mansonia wood without knowing it, this explaining their sensitization to mansonone A. Mansonia wood has been a common substitute for walnut, and many items, including knife handles, furniture, piano parts and brushes, have been manufactured from this wood (20). There is no cross-sensitivity between dahlbergiones and mansonone A (20).

Various wood species have also been called mahogany. Both patients who were sensitized to mahogany had handled Honduras mahogany (*Swietenia macrophylla* King, fam. Meliaceae), the allergen of which is not known. Some cases of ACD caused by Honduras mahogany have previously been reported (1, 21, 22). 1 of the patients, the joiner (Table 1, patient no. 9) also reacted to 2,6-dimethoxy-1,4-benzoquinone, which is a weak allergen of African mahogany species, *Khaya anthotheca* and *ivorensis* (23). The other 1 (Table 1, patient no. 8) also had occupationally induced rhinitis caused by padauk dust, confirmed by an otorhinolaryngologists's examination and local nasal challenge test. The joiner (Table 1, patient no. 9) also had positive patch test reactions to sapele (mahogany) (*Entandrophragma cylindricum* Sprague, fam. Meliaceae) (1, 3) and koto (*Pterygota bequaerti* De Wild or *macrocarpa* K. Schum., fam. Sterculiaceae). Sapele has caused solitary cases of ACD (1). 3 cases with positive patch test reactions to koto have been observed in Munich, Hamburg and Bonn, suggesting Type IV allergy (20).

Western red cedar is a well-known cause of asthma and allergic alveolitis, and there are also reports on ACD: the allergen is β -thujaplicin (1, 3, 4, 24). A positive patch test with the wood dust confirmed the diagnosis of ACD. Chamber exposure test also confirmed the patients's occupational asthma and rhinitis. Obeche is also a well-known cause of asthma (3). In the literature there is also mention of a personal communication on a patient who developed dermatitis from a toilet seat made of obeche, and who also had a positive patch test reaction to the wood (1). A positive patch test and 20 negative controls with the same dust confirmed the sensitization in our patient (6).

ACD caused by pine and spruce is rare among foresters and other woodworkers (1, 4, 25–29). The allergens of conifers include colophonium, turpen-

tine, wood tars, Δ -3-carene, α -pinene and other terpene compounds or their hydroperoxides (4, 27). Colophonium (rosin) contains about 90% resin acids such as abietic and pimaric acid, and 10% neutral components (4, 23, 28). Finnish tall oil resin also contains resin acids, but a little less (80–85%) than does colophonium (29). Sensitizers are the oxidation products of abietic and dehydroabietic acids (23, 28). The sensitization to the Finnish conifer sawdusts was confirmed by positive patch test reactions to pine saw dust, colophonium and other allergens of conifers (Table 2) (27, 28).

Contact urticaria (CU) caused by wood dusts is rarer than contact eczema (3). CU caused by obeche has been described since the 1960s (30–32). Our patient's CU was probably an IgE-mediated reaction with positive prick and RAST to obeche dust. Dermatitis caused by punah wood has not been reported previously. Our patient's CU, rhinitis and asthma were confirmed by repeated chamber challenge tests with the wood dust, but prick test and RAST were negative, suggesting non-immunologic CU.

Occupationally-induced ACD and CU caused by wood dusts are not common occupational diseases in Finland. They are mainly caused by dusts from tropical hardwoods. Often such patients also have mucosal symptoms, including conjunctivitis, rhinitis and asthma.

Skin tests are needed to differentiate between ACD and irritant contact dermatitis. Wood dusts, if not strong skin irritants, can be used as such for patch testing. It is, however, more recommendable to use the dusts mixed in petrolatum (3). Patch testing with known wood allergens will best confirm the diagnosis, and also help in the identification of wood species. Using patch testing with wood allergens also helps in the giving of better advice to prevent recurring dermatitis and changing jobs or job sites.

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