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Immediate allergic and nonallergic reactions to Christmas and Easter cacti

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Key words: atopy; conjunctivitis; contact urticaria; immediate hypersensitivity; plants; rhinitis; work-related.

Background: Occupational exposure to Christmas cacti has been reported as a cause of type I allergy. Therefore, the prevalence of immediate-type mucosal and skin reactions related to cactus exposure was studied in 103 employees in a cactus nursery.

Methods: The study was based on a questionnaire followed by clinical examination, skin prick tests (SPT) with standard inhalant allergens and cacti, and a histamine-release test (HRT/Refix) using fresh cactus extracts as elicitor.

Results: The questionnaire was answered by 84 (82%) of the nursery employees, and 63 (61%) were interviewed and skin prick tested; 58 of these were tested with HRT/Refix. Furthermore, 22 healthy controls were included and tested *in vivo* and *in vitro*. Cactus-related contact urticaria and/or rhinoconjunctivitis were reported by 37% of the cactus workers. Based on a combination of positive history, positive SPT, and positive HRT/Refix to cactus, 8% of the cactus workers were allergic to cacti. No noncactus workers or controls were allergic to cacti by these criteria. Testing with fresh cactus material elicited positive SPT and negative HRT/Refix in 27 nursery workers and controls, of whom 12 had immediate-type skin and mucosal symptoms.

Conclusions: Christmas and Easter cacti seemed to be able to induce contact urticaria and rhinoconjunctivitis on both an immunologic and a nonimmunologic basis. Personal atopy was associated with positive reactions to cacti.

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Occupational exposure to Christmas cacti (*Schlumbergera* spp.) may cause type I allergy, in the form of urticaria and rhinoconjunctivitis, in nursery workers (1). This prompted us to study the prevalence of type I allergy to cacti among employees of a cactus nursery, by means of a questionnaire

investigation supplemented with skin prick tests (SPT) and histamine-release tests (HRT). Furthermore, we assessed associations between cactus exposure and symptoms from skin and mucous membranes, as well as the incidence of cactus-related complaints of manifest or latent atopy.

Material and methods

Questionnaire study and clinical tests

Participants $\times$ were recruited from 103 persons employed at a local cactus nursery in September 1995. Furthermore, 22 healthy unmatched controls (eight men and 14 women) were recruited from the staff at the hospital. The local ethics committee approved the study protocol.

The nursery employees answered a list of 37 questions on work-related symptoms and atopy compiled from a questionnaire used in a large epidemiologic study on hand dermatoses among Finnish farmers (2) and from the questions used in an international study on atopic dermatitis (3), as well as nine additional questions on contact with cacti.

The participants were skin prick tested by routine procedure (4) with 10 common inhalant allergens (ALK-Abell ) and the so-called prick-prick test with cactus leaves. Two Christmas cactus cultivars ("Madisto" and "Malibu") and two Easter cactus cultivars ("Cetus" and "Mira") were used. The plants had not been treated with biocides for 6 months before testing.

Laboratory investigations

Preparation of cactus extracts used for *in vitro* tests

A cactus leaf was broken into four parts and extracted in Pipes AMC Buffer (1:1) for 20 min at room temperature. The supernatant was used as stock solution. Dilutions of 1:10, 1:20, 1:40, 1:80, and 1:160, and 1:320 v/v were used in the experiment. A fresh extract was made for each test series. Human α -IgE (Behringwerke AG, BRD) was used as a positive control.

Basophil histamine-release test (HRT)

The glass microfiber-based histamine-release test (HRT-Test, Reference Laboratory, Rigshospitalet, Copenhagen, Denmark) described by Stahl Skov et al. (5) was used. In short, 25 μ l of cactus extract was added to the glass microfiber-coated microtiter plates and incubated for 1 h at 37°C with 25 μ l heparinized blood. After incubation, the

microtiter plates were washed and dried at room temperature.

The microtiter plates were analyzed for the amount of glass microfiber-bound histamine in a spectrophotofluorometer (Gilson, USA) after coupling to OPT (*o*-phthaldehyde, Fluka). The amount of histamine released by the basophils was measured in ng/ml, and a release of at least 15 ng/ml was considered positive.

As the test material was not standardized, we included in each test series a blood sample from a negative control. If the control sample had a histamine release of ≥ 15 ng/ml when exposed to one or more of the cactus extracts, the results were omitted.

Passive sensitization of cord-blood basophils (Refix)

In the case of participants with nonresponding basophils, i.e., basophils releasing less than 15 ng/ml histamine when exposed to human α -IgE, cord-blood basophils were passively sensitized by incubating the blood cells from 2.5 ml cord blood with 500 μ l plasma from a participant at 37°C for 2 h. After incubation, the cells were washed twice with Pipes AMC buffer, resuspended to a final volume of 2.5 ml, and submitted to the HRT as described above. This method, Refix, has been described by Ebbesen et al. (6).

Statistics

The results of the study were evaluated by nonparametric methods (Fisher's exact test and chi-square test). As level of significance, 0.05 was used.

Definitions

Cactus allergy in this study was defined as contact urticaria, rhinitis, conjunctivitis, or asthma symptoms from exposure to cacti along with positive SPT and HRT/Refix to cacti. Atopy was defined as positive SPT to at least one of the common inhalant allergens.

Results

The questionnaire was answered by 84 (82%) of the nursery employees, and 63 (61%) were interviewed and skin prick tested; 58 of these were tested with HRT/Refix. Twenty-two healthy controls were tested *in vivo* and *in vitro*.

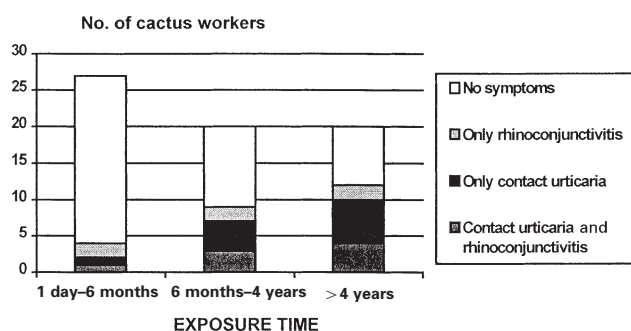


Figure 1. Prevalence of cactus-related symptoms related to duration of exposure.

Questionnaire

Of the 84 respondents, 67 (80%) had worked with cacti for at least 1 day (cactus workers), range: 1 day–30 years. The remaining 17 persons (not cactus workers) worked with other plant cultures or were clerks or technicians. Cactus workers reported cactus-related symptoms in 25 cases (37%), consisting of eight cases of combined contact urticaria and rhinoconjunctivitis, 11 cases of contact urticaria only, and six cases of rhinoconjunctivitis only. A significant increase in the prevalence of symptoms was noticed with increasing exposure time ($P < 0.007$), as shown in Fig. 1.

Cactus workers who had propagated cacti reported work-related symptoms more frequently than cactus workers exposed in other ways. During the propagation process, the cactus worker breaks off top shoots manually, thereby probably releasing a minute “aerosol” of cactus sap. Occupationally related rhinoconjunctivitis was reported more frequently among propagators than among nonpropagators. Furthermore, 19 of 21 cactus workers mentioned that propagation was the eliciting factor.

Skin prick tests

Table 1 shows the prevalence of positive SPT to the common inhalant allergens. A remarkably large number of nursery employees had positive SPT to pollen allergens. Seven of eight with positive birch-pollen SPT were cactus workers, and six reported cactus-related symptoms. Eight of 13 with positive grass-pollen SPT were cactus workers, and five reported cactus-related symptoms.

Among persons with positive SPT to the common inhalant allergens, 20/31 (65%) had positive SPT to cacti, whereas only 14/54 (26%) persons with negative SPT to the common inhalant allergens had positive SPT to cacti ($P < 0.0005$).

Table 1. Prevalence of positive SPT to basic series

Allergen	22 controls no. (%)	10 noncactus workers no. (%)	53 cactus workers no. (%)
Positive SPT for at least one allergen from basic series	7 (32%)	4 (40%)	20 (38%)
Pollens*	3 (14%)	3 (30%)	15 (28%)
Birch	0	1 (10%)	7 (13%)
Grass (timothy)	3 (14%)	2 (20%)	8 (15%)
Mugwort	2 (9%)	2 (20%)	2 (4%)
Dander*	3 (14%)	1 (10%)	4 (8%)
Horse	0	1 (10%)	1 (2%)
Dog	2 (9%)	1 (10%)	1 (2%)
Cat	2 (9%)	1 (10%)	4 (8%)
House-dust mites*	4 (18%)	1 (10%)	7 (13%)
<i>Dermatophagoides pteronyssinus</i>	4 (18%)	0	7 (13%)
<i>D. farinae</i>	2 (9%)	1 (10%)	2 (4%)
Molds*	1 (5%)	1 (10%)	1 (2%)
<i>Alternaria alternata</i>	1 (5%)	0	1 (2%)
<i>Cladosporium herbarum</i>	0	1 (10%)	1 (2%)

*Positive SPT (mean wheal diameter of 3 mm or more) to pollen, dander, house-dust mites, and molds was defined as positive SPT to at least one of allergens in group.

Discussion

In contrast to the standardized common inhalant allergens used for SPT, the fresh cactus leaves may vary in content of active components due to changing seasons, and stress caused by suboptimal care.

Several factors may have influenced the discordant results obtained in HRT/Refix and SPT. Both immunologic (ICU) and nonimmunologic contact urticaria (NICU) and symptoms from mucous membranes are frequently related to contact with plants (7, 8).

A number of substances in cacti, including plant lectins (9, 10) and alkaloids (11), may elicit unspecific histamine release. Like opioids (12), alkaloids may cause histamine release in skin mast cells, but not in blood basophils. This might be an additional explanation of the poor concordance between *in vivo* and *in vitro* tests. Furthermore, neither HRT/Refix nor SPT is allergy specific, as basophils and mast cells can release histamine, both as an IgE-mediated allergic reaction and as an unspecific response.

In HRT/Refix, proteins and dyes in the cacti could cause unspecific fluorescence due to ring formation with OPT (12). To compensate for this, we used a known nonallergic control in each HRT/Refix session. In cases where the control showed a positive reaction to one or more dilutions of cactus extracts, these extracts were omitted in the evaluation. This might in part account for the relatively numerous persons complaining of symptoms and/or having a positive cactus SPT but negative HRT/Refix. Furthermore, this may have caused allergic persons with weak responses to be classified as nonallergic, and diminished the risk of classifying nonallergic persons as false-positive.

The results indicate that cacti can cause both an allergic response and a nonimmunologic irritant reaction. The large number of positive skin reactions and unspecific reactions in HRT/Refix among negative controls indicate a non-immunologic mechanism. On the other hand, the occurrence of significantly more positive SPT reactions among cactus workers than noncactus workers and controls suggests a specific response. If the reactions were completely nonspecific, one would expect the same prevalence of positive tests in all three groups.

The fact that significantly more of the tested atopsics had a positive reaction to cacti in SPT supports the theory of a type I allergic element, as atopsics would be more inclined to develop cactus allergy than nonatopsics (13). In contrast, there was no difference in the prevalence of positive HRT/Refix among tested atopsics and nonatopsics. Duration of exposure and working with cactus propagation are important risk factors in the development of cactus allergy, probably related to increased exposure to cactus sap. The association between birch-pollen allergy and cactus-related symptoms among the nursery workers suggests a relationship between allergy to birch pollen and cacti, but it could also be coincidental. Unfortunately, we do not know whether the nursery workers were sensitized to birch pollen before they started working at the nursery, or whether the phenomenon represents cross-reactivity between cacti and birch pollen.

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