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Occupational IgE-mediated asthma, rhinoconjunctivitis, and contact urticaria caused by Easter lily (*Lilium longiflorum*) and tulip

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Background: We report on IgE-mediated asthma, rhinoconjunctivitis, and contact urticaria to two Liliaceae plants, tulip and Easter lily (*Lilium longiflorum*), diagnosed in a floral shop worker.

Methods: Occupational asthma was diagnosed according to patient history, PEF monitoring, and a work-simulating provocation test. Flower-specific IgE was studied, and RAST inhibition tests were performed.

Results: Skin prick testing showed positive reactions to tulip, Easter lily, and chrysanthemum. Total IgE was 180 kU/l, and specific IgE to tulip was 2.6 and to Easter lily 6.5 kU/l. In the RAST-inhibition test, no cross-reactivity was found. Occupational asthma was diagnosed by peak flow monitoring at work and at home, as well as specific inhalation challenge with Easter lily, with an immediate 18% reduction in PEF. In addition, contact urticaria and conjunctivitis were diagnosed. After a 9-year follow-up without exposure to lilies, the skin prick tests to *L. longiflorum* and tulip were still positive, but the specific IgE had disappeared.

Conclusions: A case of IgE-mediated occupational asthma, rhinoconjunctivitis, and contact urticaria caused by *L. longiflorum* and tulip is presented. RAST inhibition tests indicated concomitant sensitization to the two Liliaceae plants.

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The Liliaceae family contains about 3700 species in 250 genera (1). The decorative species of the Liliaceae family, such as tulip, crocus, hyacinth, and white and colored lilies, have long been popular decorative plants. Several Liliaceae species have caused contact dermatitis. "Tulip finger" (2) is well known in tulip growers, and the allergen causing the dermatitis has been identified as tuliposide-A (3, 4). However, the respiratory symptoms caused by tulip (4–7) and other Liliaceae plants are less known. Other Liliaceae



Figure 1. Easter lily (*Lilium longiflorum*).

species that have caused occupational asthma are garlic (8) and hyacinth (9).

Easter lily (*Lilium longiflorum*) belonging also to the Liliaceae family, is often used in funeral or bridal decorations (Fig. 1). One case report of contact urticaria, and nasal and asthmatic symptoms caused by tulips and Easter lily has been published by Lahti (5). Immediate skin reactions to several varieties of tulip and Easter lily were positive in scratch chamber tests (5). However, no lung function tests, specific inhalation challenge test, or specific IgE measurements were performed in the study.

In 1989, we had diagnosed one case of asthma, rhinoconjunctivitis, and contact urticaria caused by tulip and Easter lily in one patient. We recently called in the patient for control examinations, and report here the case and the specific challenge testing as well as the results of allergologic examinations performed in 1989 and 1998.

Material and methods

Spirometry was performed with a rolling-seal spirometer (Mijnhardt, Vicatest 3) connected to a microcomputer (Medicro MR-3), with Viljanen's spirometry reference values (10). In the histamine challenge testing, in 1989, a modification of the method of Laitinen (11) was used; and, in 1998, Sovijärvi et al.'s method (12). The FEV₁ (forced expiratory volume in 1 s) values were followed up with a Vitalograph S bellow spirometer (Vitalograph, Buckingham, UK). In Sovijärvi et al.'s method, a 15% reduction in FEV₁ is considered significant and the provocative dose of histamine diphosphate causing a 15% reduction in FEV₁ (PD₁₅) is measured. The hyperresponsiveness is graded as strong with PD₁₅ <0.10 mg, moderate with 0.11–0.40 mg, and slight

Table 1. Results of skin prick testing (diameter of wheal in millimeters) with common environmental allergens, serum total IgE and flower-specific IgE measurements in 1989

Histamine	4
Common environmental allergens	
Birch	3
Alder	3
Tulip	
Stalk	5
Leaf	6+ps
Petals	nd
Pollen	nd
Easter lily	
Stalk	4
Leaf	5+ps
Petals	5
Pollen	nd
Specific IgE (kU/l)	
Birch	15.7
Alder	11.5
Tulip	2.6
Chrysanthemum	<0.3
Easter lily	6.5
Hyacinth petals	<0.3
Hyacinth stalk	<0.3
Daffodil	<0.3
Total IgE (kU/l)	180
Nd=not done; ps=pseudopodia. <0.3 kU/l as specific IgE titer means negative result.	

with 0.41–1.6 mg. The histamine diphosphate was given with a dosimeter.

As a placebo inhalation test, oil of mint (*Menthae piperitae* aetheroleum; Ph. Eur. 2nd ed. [405]; Oriola Co. Espoo, Finland) was used in 1989; in 1998, lactose was used. During the specific inhalation-challenge tests, the flowers were cut or handled for 30 min in a challenge chamber, and the challenge test was carried out by the method described by Newman-Taylor et al. (13). In 1989, PEF (peak expiratory flow) was followed up with a Wright peak flow meter (Clement Clarke M286, Ferraris Medical), and the FEV₁ values with a Vitalograph S bellow spirometer (Vitalograph, Buckingham, UK) by a method reported earlier (14). In 1998, FEV₁ and PEF were followed up with a Micro Plus Spirometer (Micro Medical, UK) (15). For the diagnosis of asthma, a reduction of peak flow or FEV₁ by at least 20% was regarded as significant. The long-term peak flow recordings at home and at work were done by the method of Burge (16) with a mini-Wright peak flow meter. The reactions of the skin and mucosa were examined by a dermatologist.

The routine skin prick test was done with 20 environmental inhalant allergens (Allergologisk Laboratorium A/S, ALK, Copenhagen, Denmark). In addition, prick tests were also done with pollen, stalks, bulbs, or petals of the flowers, as reported earlier (17). The skin patch tests with flowers

Table 2. RAST inhibition studies of serum with tulip or lily dry extracts

Concentration of inhibiting extract	Inhibition (%)
Tulip RAST	
0 mg/ml (control)	0
Easter lily 50 mg/ml	14
Easter lily 5 mg/ml	3
Easter lily 0.5 mg/ml	10
Tulip 50 mg/ml	78
Lily RAST	
0 mg/ml (control)	0
Tulip 50 mg/ml	7
Tulip 5 mg/ml	2
Tulip 0.5 mg/ml	0
Lily 50 mg/ml	97

were done with the occlusive Finn Chamber[®] technique, as described earlier (18, 19). The skin tests were done with similar methods, both in 1989 and in 1998.

The specific IgE to birch and alder was measured by the CAP FEIA technique (Pharmacia, Sweden), according to the manufacturer's recommendations. The flower-specific IgE to tulip and Easter lily were measured by the radio-allergosorbent test (RAST). Defatted flower extractions from the whole plant without bulb (20) were coupled with cyanogen bromide-activated paper disks by the method of Ceska et al. (21). Cross-allergenicity studies between tulip and lily were determined by a modification of the RAST inhibition test (22). Volumes of 50 µl of the patient's serum and 20 µl of the inhibiting flower extracts with decreasing concentrations were incubated overnight at 2–8°C, after which the specific IgE was determined as described above. The degree of RAST inhibition was obtained by comparing the radioactivity of the inhibited samples with samples containing the same volume of saline.

Patient

The patient was a 47-year-old nonsmoking woman who had been working in a floral shop for 11 years handling, cutting, binding, and selling flowers. She did not have atopic symptoms as a child. She had suffered from rheumatoid arthritis for 15 years and was treated with sodium aurothiomalate injections once a month, and a knee operation had been performed. Otherwise, she had been healthy.

For 5 years, she had suffered from rhinitis, irritation of the eyes, cough, and dyspnea. The symptoms got worse at work, especially when she handled tulips, Easter lilies, and

hyacinths. Symptoms of wheezing dyspnea appeared also during the night after handling these flowers. In 1985, asthma had been diagnosed, based on peak flow variation. Since then, she had used inhaled salbutamol on demand.

In 1989, she was admitted to the Finnish Institute of Occupational Health because of suspicion of occupational asthma. In addition, she had work-related rhinitis, conjunctival redness, and urticaria of the neck and face. A diagnosis of occupational asthma and contact urticaria was established by the examinations at the Finnish Institute of Occupational Health, and the patient was considered incapable of working in a floral shop. The patient then retired. She was summoned to control examinations in 1998. She had not been exposed to Easter lilies since 1989, but she had bought tulips for her home a couple of times a year. When exposed to tulips, especially yellow tulips, she often felt similar symptoms. She used inhaled salbutamol on demand. In addition, hyacinths and daffodils caused her respiratory symptoms. At home, she had several house plants: spathe flower (*Spathiphyllum wallisii*, Araceae family), golden pothos (*Scindapsus aureus*, Araceae), aralia (*Fatsia japonica*, Araliaceae), Amazon lily (*Eucharis x grandiflora*, Amaryllidaceae), and spider plant (*Chlorophytum comosum*, Liliaceae), but she did not get respiratory symptoms from them.

Results

In 1989, spirometry showed slight obstruction without significant response in the bronchodilation test of our patient (FVC 4.38 l, 121% of predicted, FEV₁ 3.08 l, 103% of predicted, normal; and FEV₁/FVC 69.95%, 85% of predicted, slightly lowered). The histamine challenge test showed moderate bronchial hyperactivity. In skin prick tests with common inhalant allergens, birch and alder extract gave slightly positive results. The patient's prick tests to parts of tulips and Easter lily were positive (Table 1), and in control patients ($n=5$ in 1989, $n=20$ in 1998) negative. Patch tests to a modified European standard series were negative, as were patch tests with tulip and Easter lily (stalk, leaf, and petals). The patient's total serum IgE was slightly elevated, and specific IgE to tulip and Easter lily were positive, but negative to chrysanthemum, daffodil, and hyacinth (Table 1). Peak flow monitoring at work and at home indicated occupational asthma; PEF varied 30–50% during working days and 9–17% during days off, although the patient used regular budesonide inhalations 800 µg and salbutamol 200 µg a day. In a specific challenge test with

Easter lily, an 18% immediate peak flow reduction was found, as well as a late 22% reduction on the next morning; however, the latter deviated only 11% from the placebo challenge level. In addition, itching and redness of the eyes, nasal drip, and itching of the skin and urticarial whealing of the neck were noted immediately after the challenge test.

In the control examinations in 1998, spirometry showed slight obstruction without response in the bronchodilation test (FVC 4.06 l, 121% of predicted, FEV₁ 2.82 l, 104% of predicted, normal; and FEV₁/FVC 67.02%, 85% of predicted, slightly lowered). The histamine challenge test showed slight bronchial hyperreactivity, PD₁₅ 1.169 mg. Skin prick tests to tulip stalk, leaves, and petals, and Easter lily petals and pollen were positive, but the RASTs were negative. Total IgE of serum was 35 kU/l. In the specific challenge test, a nonsignificant maximal 10% reduction in FEV₁ was found after challenge test with Easter lily; and an immediate 16% and a 17% late reduction after the challenge test with yellow tulip. In addition, itching and redness of the eyes were induced during both inhalation challenges, and they were cured by cromolyn sodium drops. No skin changes were seen during the challenge testing.

Tulip did not inhibit lily, and lily did not inhibit tulip in the RAST inhibition tests (Table 2).

Discussion

Our patient felt respiratory symptoms from several Liliaceae family plants, i.e., cough, and redness of the eyes and the skin during her work, and asthmatic symptoms early the next morning after exposure to the lilies. The reaction in the work-simulated challenge testing with Easter lily remained suggestively positive because of her unstable asthma condition. The PEF follow-up at home and at work, however, pointed to occupational asthma, despite her regular inhaled steroid and β -sympathomimetic medication. In addition, the positive skin prick tests with flowers, and positive tulip-specific IgE also confirmed the occupational cause of the disease in 1989.

Nine years later, IgE antibodies specific to both tulip and Easter lily were found in the patient's serum from the year 1989 (stored at -70°C), while the tests with the serum from 1998 were negative. The flower-specific IgE was prepared in the same series in 1998, so the allergen could not be different. After the patient was no longer constantly exposed to lilies and tulips for 9 years, her serum total IgE level also had fallen. In 1998, however, the corresponding skin prick tests were positive, despite the cessation of the exposure.

We have earlier found positive prick test results to both tulip and Easter lily in the same patient, as reported also by Lahti (5). We therefore studied the old serum of one patient, earlier diagnosed to have asthma caused by tulip (23); we found that the RAST was positive (3.6 kU/l) to Easter lily, as well. The RAST-inhibition test did not show inhibition in the present case, or in the other one, indicating concomitant sensitization to both plants, rather than a cross-reaction. We did not have enough old serum to conduct immunoblotting studies. Because the patient felt symptoms also at exposure to hyacinth (Liliaceae family) and daffodil (Amaryllidaceae family), RAST studies with these were also performed, but they did not show specific sensitivity to them. The patient's symptoms caused by hyacinth and daffodil may be nonspecific, or may be an irritant effect of the plant's strong scent.

We have earlier found a case of occupational asthma to hyacinth that was IgE negative (9), suggesting that different mechanisms of the Liliaceae family cause occupational asthma. The present case demonstrates that tulip and Easter lily may cause IgE-mediated respiratory allergy simultaneously in the same patient. The allergens in these plants are probably not the same. The exact identification of the allergens requires further studies.

Earlier, about 20 decorative flowers have been reported to cause respiratory symptoms (7). The present case confirms the preliminary results of Lahti (5); i.e., that Easter lily also causes IgE-mediated asthma, and allergic diseases of the skin and mucosa. The respiratory and mucosal symptoms of workers handling plants of the Liliaceae family have also to be examined carefully.

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