

Carrot-induced asthma: Immunodetection of allergens

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CASE REPORTS

Patient 1

A 40-year-old woman with seasonal allergic asthma, who was a nonsmoker, was first seen with sneezing, rhinorrhea, contact urticaria on her hands and face, coughing, and wheezing within few minutes of handling raw carrots. In addition, shortly after ingestion of raw carrots, she experienced oropharyngeal itching, hoarseness, cough, and wheezy dyspnea. She reported no symptoms after eating cooked carrots or parsley, and she did not recall that she had eaten celery or other Apiaceae spices.

Patient 2

A 48-year-old woman with intrinsic asthma, who was a nonsmoker, was first seen with oropharyngeal itching, swollen throat, and dyspnea a few minutes after eating raw carrots. Similar but milder symptoms developed on eating cooked carrots. When handling raw carrots, she reported itching on her hands, palpebral angioedema, ocular and nasal itching, and rhinorrhea. She could eat Apiaceae spices, and she did not recall that she had eaten celery.

METHODS

Allergen extracts

Fresh raw carrots and celery were lyophilized and then dissolved in phosphate-buffered saline at 1:5 wt/vol (protein concentration of carrot extract: 0.58 mg/ml). Extracts of Apiaceae spices (cumin, coriander, anise, caraway, parsley, and fennel) were prepared at 1:10 wt/vol in phosphate-buffered saline as previously described.¹

RESULTS

Skin tests

Results of skin prick tests with common inhalants (ALK-Abelló, Madrid, Spain) were positive (mean wheal diameter >3 mm) in response to grass pollen and negative in response to mugwort and birch pollens in patient 1, and all results were negative in patient 2. Skin tests were also performed (prick by prick) with fresh and cooked carrots (75° C for 30 minutes). Histamine release tests were carried out by using an automated fluorometric method.² Results of skin and histamine release tests were positive in response to raw and cooked carrots, celery, and the Apiaceae spices in both patients (except

Abbreviations used

BPT: Bronchial provocation test
MW: Molecular weight

parsley in patient 1). Results of the same tests performed in 10 atopic subjects were negative.

IgE determinations

Total serum IgE was 43 kU/L in patient 1 and 38 kU/L in patient 2. Specific IgE to carrot (CAP System FEIA; Pharmacia, Uppsala, Sweden) was positive in both patients (0.51 kU/L and 2.29 kU/L, respectively) and specific IgE to celery (CAP system FEIA) was negative in patient 1 and positive in patient 2 (2.67 kU/L). Specific IgE to mugwort and birch pollens, recombinant (r)Bet v 1, and rBet v 2 (profilin) (CAP system FEIA) were all negative in both patients.

Allergen challenge tests

Bronchial provocation test (BPT) with carrot extract (1:10 wt/vol) was performed in patient 1 as previously described¹ and elicited a fall in FEV₁ of 30% from baseline 10 minutes after challenge without late response. The results of a methacholine inhalation test were within normal range. Eosinophil cationic protein in patient's serum (Pharmacia CAP system ECP FEIA) increased from 10.5 µg/ml before specific BPT to 21 µg/ml 24 hours after BPT. The result of a conjunctival challenge test was markedly positive with carrot extract at 1:20 wt/vol in patient 2. Results of BPT and conjunctival challenge with carrot extract in two control subjects were negative.

Immunoblotting

Raw carrot and celery extracts were run on a 15% acrylamide gel in nonreducing conditions, transferred to nitrocellulose membranes, incubated with patient's serum diluted 1:5, and then incubated with either monoclonal anti-human IgE or anti-IgG₄ conjugated with alkaline phosphatase. Immunoblots of raw carrot showed three IgE-binding bands with apparent molecular weights (MWs) of 42, 31, and 23 kd and two weak bands between 87 and 66 kd (Fig. 1). No allergenic components were clearly evident in the celery extract, and only traces of a band of 44 kd could be observed. IgG₄ immunoblots showed four bands in raw carrot with

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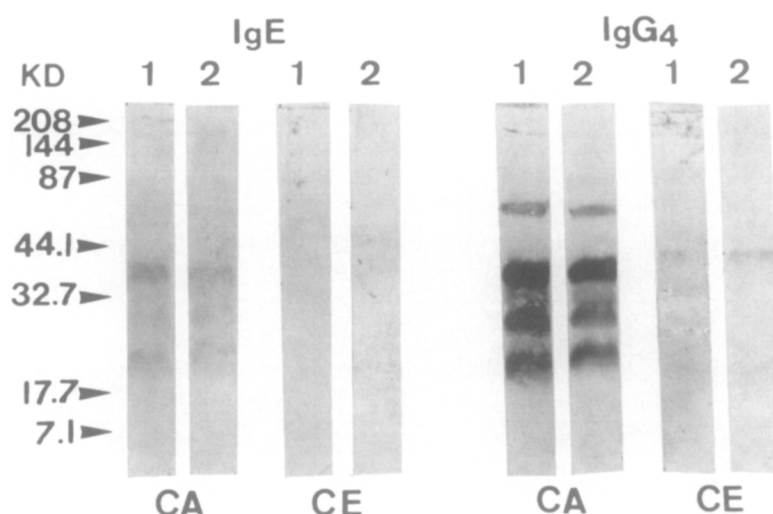


FIG. 1. IgE and IgG₄ immunoblots of carrot (CA) and celery (CE) extracts with serum samples from patients 1 and 2. No bands with apparent MW lower than 20 kd were observed.

MWs of 66, 42, 31, and 23 kd and a discrete band of about 44 kd in celery. No bands were observed in carrot and celery immunoblots when serum from a nonatopic subject was used (not shown).

DISCUSSION

Carrots have rarely been described as a cause of asthma,³ and no previous reports of carrot-induced asthma have been confirmed by objective tests. We report two patients in whom sensitization to carrot was demonstrated by results of immunologic tests and challenge procedures. Moreover, hypersensitivity to celery and Apiaceae spices was observed. Specific IgE to celery, however, was negative in patient 1. This might be due to the lower sensitivity of serologic tests compared with skin tests, especially in the diagnosis of allergy to fresh vegetables when commercially available antigens are used.¹ The fact that one of our patients could eat cooked carrots may be due to destruction or extraction of carrot allergens by cooking.^{3,4} Unlike previous reports,^{3,4} no bands with MW lower than 20 kd were detected in carrot immunoblots.

Hypersensitivity to carrot is frequently associated with allergy to celery and Apiaceae spices and sensitization to birch and mugwort pollens, which is due to cross-

allergenicity among them.³ Bet v 1 and Bet v 2 and their homologs have been identified as cross-reacting structures in birch pollen, fresh fruits, and vegetables.⁵ In patients with carrot allergy without associated sensitization to birch and mugwort pollens, however, neither Bet v 1 nor profilin appears to be a relevant allergen, suggesting that additional allergens may induce sensitization.

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