

Cabbage Allergy: A Rare Cause of Food-induced Anaphylaxis

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Accepted Sep 25, 2012; Epub ahead of print Dec 20, 2012

Broccoli (*Brassica oleracea* var. *Italica*) belongs to the mustard/cabbage family, *Brassicaceae*. Other vegetables in this botanical family are cauliflower, cabbage, turnip, kale and Brussels sprouts. All of these are regarded as replacement vegetables in the diet of subjects allergic to pollen-associated food.

CASE REPORT

We report here the case of a 42-year-old Caucasian woman, who experienced 2 anaphylactic episodes in the 6 months prior to presentation, following ingestion of vegetables including broccoli. She developed angioedema of the lips and dyspnoea twice, both times necessitating emergency treatment. The patient had previously experienced similar episodes of angioedema following ingestion of peach and chamomile tea. Once, she experienced generalized urticaria after eating tree nuts and berry fruits. The patient has a 20-year positive history of allergic rhinoconjunctivitis during the summer months. No other allergic diseases, such as atopic dermatitis, asthma or contact dermatitis, e.g. nickel sensitization were known. Due to paroxysmal tachycardia the patient took a beta-blocker during the onset of the reactions, which was switched to a calcium antagonist prior to the challenge procedures.

Skin-prick test (SPT) with commercial inhalant pollen allergens (ALK-Abelló, Wedel, Germany) was positive for grass (7 mm), mugwort (5 mm) and ambrosia (8 mm). SPT with food allergen extracts (ALK-Abelló) and fresh food were positive for native hazelnut and wheat extract (4 mm each), peanut extract, native lupin and raw broccoli (5 mm each) and for paprika spice (6 mm). SPT to the lipid transfer protein (LTP) from peach (5 mm) was also positive. Total immunoglobulin E (IgE) level (ImmunoCAP System, Thermo Fisher Scientific, Uppsala, Sweden) was 94.6 kU/l. Specific IgE (sIgE) was positive for mugwort (6.65 kU/l), grass (2.89 kU/l), bell pepper (0.83 kU/l), and LTP of peach (Pru p 3, 12.30 kU/l) and mugwort (Art v 3, 1.76 kU/l). The sIgE for broccoli was below the detection limit (0.13 kU/l).

Double-blind, placebo-controlled food challenges (DBPCFC) were performed with bell pepper, lupin and broccoli. After ingesting cooked broccoli (80 g) the patient developed intensive long-lasting oral allergic symptoms with a mucosal erythema and a numbness of the tongue. The placebo, bell pepper and lupin challenges were negative.

DISCUSSION

As cooked broccoli elicited the symptoms in our patient, we suspected LTP to be the allergen responsible. LTPs are assumed to be highly thermostable and resistant to peptic digestion (1). It has been described that extensive heating can unfold LTPs, e.g. of wheat or barley (2, 3). However, those LTPs are structurally distinct from fruits and vegetables (4).

LTP in broccoli was identified in 1994 as the major protein on the surface of broccoli leaves (5). Homologous LTP is present in cabbage (Bra o 3) (6). LTPs are important food allergens causing severe reactions due to cross-reactivity among botanically related and unrelated fruit and vegetables (7, 8), but also local allergic symptoms have been reported in LTP-sensitized subjects (9). Thus, a link between inhalant sensitization to pollen LTP (such as Art v 3) and LTP-associated food allergy has been proposed (6, 10). In our patient the cross-reactive allergen may be Pru p 3, the peach LTP, but also Art v 3, the mugwort LTP, cannot be excluded as the patient has a history of rhinoconjunctivitis caused by mugwort pollen for several years.

Although, sIgE to broccoli was low, SPT and DBPCFC with broccoli were positive. One reason for the low IgE reactivity might be that the broccoli LTP is under-represented in the *in vitro* test system, resulting in false-negative results.

Thus far, no reports of broccoli allergy have been published. In the anaphylaxis-registry of German-speaking countries data from anaphylactic reactions have been collected since 2006 (11–13). Until 2010, a total of 2,114 anaphylactic cases were registered, of which 399 were caused by food and, more specifically, 34 were caused by vegetables ($n=34$). However, only one anaphylactic reaction has been registered as being caused by a representative of the cabbage family (cauliflower). In this case, a 12-year-old boy developed urticaria, dyspnoea and a reduction in blood pressure after eating cauliflower in combination with physical activity (14). The registration of one severe allergic reaction during 4 years supports that cabbage-related food anaphylaxis is rare, but on the other hand cannot be excluded as such.

The authors declare no conflicts of interest.

REFERENCES

1. Mills EN, Mackie AR. The impact of processing on allergenicity of food. *Curr Opin Allergy Clin Immunol* 2008; 8: 249–253.
2. Pastorello EA, Farioli L, Conti A, Pravettoni V, Bonomi S, Iametti S, et al. Wheat IgE-mediated food allergy in European patients: alpha-amylase inhibitors, lipid transfer proteins and low-molecular-weight glutenins. Allergenic molecules recognized by double-blind, placebo-controlled food challenge. *Int Arch Allergy Immunol* 2007; 144: 10–22.
3. Perrocheau L, Bakan B, Boivin P, Marion D. Stability of barley and malt lipid transfer protein 1 (LTP1) toward

- heating and reducing agents: relationships with the brewing process. *J Agric Food Chem* 2006; 54: 3108–3113.
4. Jenkins JA, Griffiths-Jones S, Shewry PR, Breiteneder H, Mills EN. Structural relatedness of plant food allergens with specific reference to cross-reactive allergens: an in silico analysis. *J Allergy Clin Immunol* 2005; 115: 163–170.
 5. Pyee J, Yu H, Kolattukudy PE. Identification of a lipid transfer protein as the major protein in the surface wax of broccoli (*Brassica oleracea*) leaves. *Arch Biochem Biophys* 1994; 311: 460–468.
 6. Palacin A, Cumplido J, Figueroa J, Ahrazem O, Sanchez-Monge R, Carrillo T, et al. Cabbage lipid transfer protein Bra o 3 is a major allergen responsible for cross-reactivity between plant foods and pollens. *J Allergy Clin Immunol* 2006; 117: 1423–1429.
 7. Asero R, Mistrello G, Roncarolo D, de Vries SC, Gautier MF, Ciurana CL, et al. Lipid transfer protein: a pan-allergen in plant-derived foods that is highly resistant to pepsin digestion. *Int Arch Allergy Immunol* 2000; 122: 20–32.
 8. Asero R, Mistrello G, Roncarolo D, Amato S, Caldironi G, Barocci F, et al. Immunological cross-reactivity between lipid transfer proteins from botanically unrelated plant-derived foods: a clinical study. *Allergy* 2002; 57: 900–906.
 9. Reuter A, Lidholm J, Andersson K, Ostling J, Lundberg M, Scheurer S, et al. A critical assessment of allergen component-based in vitro diagnosis in cherry allergy across Europe. *Clin Exp Allergy* 2006; 36: 815–823.
 10. Lombardero M, Garcia-Selles FJ, Polo F, Jimeno L, Chamorro MJ, Garcia-Casado G, et al. Prevalence of sensitization to *Artemisia* allergens Art v 1, Art v 3 and Art v 60 kDa. Cross-reactivity among Art v 3 and other relevant lipid-transfer protein allergens. *Clin Exp Allergy* 2004; 34: 1415–1421.
 11. Hompes S, Kirschbaum J, Scherer K, Treudler R, Przybilla B, Henzgen M, et al. Erste Daten der Pilotphase des Anaphylaxie-Registers im deutschsprachigen Raum. *Allergo J* 2008; 17: 550–555.
 12. Hompes S, Scherer K, Köhli A, Rueff F, Mahler V, Lange L, et al. Nahrungsmittelanaphylaxie: Daten aus dem Anaphylaxie-Register. *Allergo J* 2010; 19: 234–242.
 13. Hompes S, Kohli A, Nemat K, Scherer K, Lange L, Rueff F, et al. Provoking allergens and treatment of anaphylaxis in children and adolescents – data from the anaphylaxis registry of German-speaking countries. *Pediatr Allergy Immunol* 2011; 22: 568–574.
 14. Striegel AK, Buderus S, Lange L. Verdacht auf eine Exercise-induced Anaphylaxie auf Blumenkohl bei einem 12-jährigen Jungen. *Allergologie* 2011; 34: 555–559.