

Food-Dependent Exercise-Induced Anaphylaxis to Lentil and Anaphylaxis to Chickpea in a 17-Year-Old Boy

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■ Abstract

We report the case of a 17-year-old boy who experienced 4 episodes of exercise-induced anaphylactic reaction after ingestion of lentil and 2 episodes of anaphylaxis following ingestion of chickpea. His medical history revealed that he had allergic rhinitis with positive results after skin prick tests (SPT) with mites. His SPTs and specific immunoglobulin E antibody testing with lentil and chickpea were positive. Oral challenge with chickpea was not performed due to patient refusal. Treadmill exercise challenge tests in the fasting state and 1 hour after a meal not containing lentil were negative. However, an exercise challenge test 1 hour after intake of lentil soup resulted in pruritus of the hands, forearms, shoulders, and back, urticarial lesions on the face and shoulders, mild angioedema of the lips, and mild hoarseness and cough. To our knowledge, this is the first case of food-dependent exercise-induced anaphylaxis due to lentil.

Key words: Food-dependent exercise-induced anaphylaxis. Lentil. Anaphylaxis. Chickpea.

■ Resumen

Describimos el caso de un niño de 17 años con antecedente de 4 episodios de reacción anafiláctica inducida por ejercicio, tras ingesta de lenteja y 2 episodios de anafilaxia tras la ingesta de garbanzo. Su historia clínica revelaba que sufría rinitis alérgica con pruebas cutáneas positivas frente a ácaros. Las pruebas cutáneas y la determinación de la inmunoglobulina (Ig) E específica frente a lenteja y garbanzos fueron positivas.

La provocación oral con garbanzo no se realizó por rechazo del paciente.

Los test de provocación con ejercicio sobre cinta rodante realizados en ayunas y una hora tras la ingesta de una comida que no contenía lentejas fueron negativas. Sin embargo, la provocación con ejercicio una hora tras la ingesta de sopa de lentejas resultó en prurito de manos, antebrazos, hombros y espalda, lesiones urticariales en la cara y hombros, leve angioedema labial y ligera disfonía y tos. A nuestro entender, este es el primer caso de anafilaxia inducida por ejercicio dependiente de alimentos por lenteja.

Palabras clave: Anafilaxia alimentaria inducida por ejercicio. Lenteja. Anafilaxia. Garbanzo.

Introduction

Food-dependent exercise-induced anaphylaxis (FDEIA) is a subtype of exercise-induced anaphylaxis (EIA) that is related to the intake of a specific food [1-3]. Anaphylaxis only occurs after consumption of a food allergen if this is followed by exercise or vigorous physical activity within a few hours of the consumption. Although first reported by Maulitz et al in 1979 [4] as a previously undescribed late allergic reaction to shellfish induced by strenuous exercise, FDEIA was initially described in 1983 by Kidd et al [5], who

reported 4 cases of EIA occurring only after the ingestion of food. Since then, there have been many reports of FDEIA associated with cereals, seafood, peanut, tree nuts, eggs, milk, and vegetables [6-9].

Lentil (*Lens culinaris*) and chickpea (*Cicer arietinum*) are members of the Leguminosae family and are among the most frequent foods associated with immunoglobulin (Ig) E-mediated hypersensitivity reactions, particularly in pediatric patients in the Mediterranean area [10,11].

We report the case of a patient who suffered from FDEIA with lentil and anaphylaxis with chickpea.

Case Description

The patient was 17-year-old male residential student who reported suffering from pruritus, diffuse warmth, and facial erythema followed by generalized urticaria, edema of the eyelids, lips and tongue, wheezing, dyspnea, and short-term unconsciousness 30 to 60 minutes after beginning any kind of physical exertion immediately after ingestion of lentil soup. Although he experienced 4 separate episodes, he received medical aid only for the latest episode, which occurred after a football game. He was treated with antihistamines and methylprednisolone and recovered within 1 hour. According to his medical history, the first episode occurred after a football game and included pruritus, diffuse warmth, and large urticarial lesions on the arms and trunk. The second and third episodes occurred after jogging and included pruritus, urticarial lesions on the trunk, and mild edema of the eyelids. He reported that his first 3 episodes were of relatively shorter duration than the latest episode and that he recovered spontaneously within 20 to 30 minutes with no wheezing, dyspnea, or unconsciousness. He experienced no reaction to lentil soup (1 bowl, approximately 250 mL) if consumed without subsequent physical exertion. He also described 2 episodes during the last year of pruritus and tingling of the lips and tongue followed by generalized urticaria, edema of the eyelids, lips and tongue, mild stridor, wheezing, and shortness of breath that began immediately after ingestion of chickpea. Although he was treated with antihistamines and methylprednisolone and advised to avoid meals including chickpea, no diagnostic procedure was performed nor was any treatment plan—including self-injectable adrenaline—prescribed. He reported having no reactions following consumption of other legumes. He also reported mild nasal obstruction with nasal pruritus and sneezing over the last 4 years that manifested mainly in autumn and winter, for which his family doctor prescribed antihistamines and nasal steroids.

The physical examination was normal, as were complete blood counts, biochemistry, urinalysis, and complement levels. Total serum IgE was 117 $\mu\text{g/L}$. Skin prick tests (SPTs) with common inhalants (Allergopharma, Reinbek, Germany) were positive to *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*. We performed SPTs (Allergopharma, Reinbek, Germany) and prick-prick tests with various legumes including lentil, chickpea, bean, soy, peanut, and pea. Wheal and flare reactions in SPTs and prick-prick tests with lentil were 9/11 mm and 8/11 mm, and with chickpea they were 7/9 mm and 7/10 mm, respectively. SPTs and prick-prick tests with bean, soy, peanut, and pea were negative. Specific IgE antibodies to lentil and chickpea (CAP-FEIA Pharmacia, Uppsala, Sweden) were 13.9 kU_A/L and 11.3 kU_A/L , respectively. Specific IgE antibodies to bean, soy, peanut, and pea were all below 0.35 kU_A/L . An open oral challenge test with lentil soup in progressively increasing doses (1, 5, 10, 30, 75, and 125 mL) every 15 minutes was negative. Oral challenge with chickpea was not performed due to patient refusal. An exercise test was carried out under 3 different conditions on 3 different days. Exercise testing consisted of running on an inclined motor-driven treadmill (5.5°) for 8 to 10 minutes. Speed was adjusted during the run

to achieve a steady-state heart rate of at least 80% of calculated maximum age-related heart rate for the last 6 minutes of the running time. Forced expiratory volume in 1 second (FEV_1) was determined before exercise and 2, 5, 10, 15, 30, and 60 minutes after exercise. Heart rate and oxygen saturation were monitored throughout the exercise and the blood pressure was taken before and after.

A fasting treadmill exercise challenge, followed by an exercise challenge 1 hour after a meal without the suspected food, and finally an exercise challenge 1 hour after the ingestion of 250 mL of lentil soup (the maximum amount tolerated by the patient without subsequent physical exertion) were performed. The patient and his parents gave their verbal and written consent before the challenge procedures with lentil. Challenge tests were performed in a room with immediate access to an intensive care unit. The serum tryptase level was not determined, even though an objective reaction developed, since the test is not available in Turkey. Treadmill exercise challenge tests in the fasting state and 1 hour after a meal not containing lentil were negative. However, specific food and exercise challenge 1 hour after lentil soup intake resulted in pruritus of the hands, forearms, shoulders, and back, urticarial lesions on the face and shoulders, mild angioedema of the lips, and mild hoarseness and cough. There was no bronchospasm and the patient did not lose consciousness. His symptoms resolved within 1 hour after immediate treatment with pheniramine maleate and methylprednisolone, and he was discharged after 6 hours under observation. The values for baseline and postexercise spirometry, oxygen saturation, and blood pressure were within the normal range in all 3 exercise challenges.

On discharge, he was advised to avoid chickpea and exercise within 4 hours of consuming lentil, and self-injectable epinephrine and antihistamine were prescribed.

Discussion

To our knowledge, this is the first case of FDEIA due to lentil. The patient's history, the positive prick test responses with lentil, the negative treadmill exercise challenge tests in the fasting state and 1 hour after a meal not containing lentil, the negative open oral challenge test with lentil soup, and the positive specific food exercise challenge after lentil soup indicate that our patient had IgE-mediated FDEIA to lentil.

Although the exact mechanism of FDEIA is unknown, an IgE-mediated mechanism is suggested in the light of the SPTs and/or specific IgE results for the causative foods. However, it is not clear which exercise-specific factors or combination of factors upregulate immune responses and/or facilitate the transient loss of immune tolerance to the causative foods. The following mechanisms have been proposed: (1) the release of exercise-induced interleukin (IL)-6, which may activate tissue transglutaminase (tTG), an enzyme able to modify protein peptides (ie, specific glutamine residues in wheat allergens, specifically ω -5 gliadin) and facilitate IgE cross-linking and release of histamine from mast cells [12]; (2) gut permeability during exercise [13], which has been shown to increase in food-allergic and food-intolerant children [14]; and (3) a possible

association with abnormalities of the autonomic nervous system, leading to an increase in parasympathetic activity and a reduction in the responsiveness of the sympathetic system as demonstrated by preliminary studies in children [15].

The symptoms in anaphylactic episodes as defined by the patient and as observed under controlled conditions varied in severity. We cannot state with certainty whether this was due to the different intensities of exertion during the episodes. It has also been concluded that the symptoms of FDEIA may not always be reproduced, even with the same amount and type of exercise, and that associated factors, such as the timing of the challenge and climatic conditions, may play an important role [16].

Patients with FDEIA generally have asthma and other atopic disorders [17]. On the basis of our patient's medical history and positive SPT results with mites, he was diagnosed as having perennial allergic rhinitis.

Our patient also reported 2 anaphylactic episodes following ingestion of chickpea. Although the gold standard for diagnosing food allergy is a double-blind placebo-controlled food challenge, we were unable to perform oral challenge due to patient refusal. However, his convincing history, positive SPT results and specific IgE results strongly indicated chickpea allergy. Although evident clinical and immunological cross-reactivity has been demonstrated with legumes [18], our patient did not report allergic reactions to other legumes.

This case is particularly interesting since one legume (chickpea) induced anaphylaxis under baseline conditions while another (lentil) induced anaphylaxis only after exercise. It has been suggested that many allergen-related factors (eg, resistance to digestive enzymes, allergen concentration, ripening, cooking, solubility) may determine the clinical appearance of an allergic reaction [19]. Cofactors such as exercise or alcohol ingestion may increase the absorption of poorly soluble proteins that are less likely to elicit reactions, as has been shown at least for wheat-gamma-gliadin, an essentially water-insoluble protein [20]. However, we are unable to offer an explanation, since we did not determine which allergenic proteins of lentil and chickpea were responsible for these different reactions in our patient.

There are few data on the prevalence of FDEIA in childhood. In Japan, a questionnaire-based prevalence study of 76 226 junior high school students revealed a prevalence of 0.017% [21]. However, with the increased popularity of physical exercise in the last few decades, the incidence of FDEIA might be expected to increase.

In conclusion, physicians should consider FDEIA in patients with a consistent medical history and physical findings. Patients with suspected FDEIA should avoid exercise or vigorous activity, especially when alone, for at least 4 hours after eating until the specific food(s) can be identified. Diagnosis should be based on medical history, determination of specific IgE to the suspect food(s), and a challenge test consisting of ingestion of the suspected food followed by intense physical exercise. However, the challenge test should be performed under controlled conditions, given the possibility of anaphylactic shock. Finally, all patients with FDEIA should carry prescribed auto-injectable epinephrine and antihistamines for emergency situations.

Conflicts of Interest:

The authors declare no conflicts of interest.

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