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Allergology International

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Letter to the Editor

Green tea-induced anaphylaxis: The first pediatric case report

Dear Editor,

Green tea, of which there are several varieties, is brewed from the dried leaves of the tea plant (*Camellia sinensis*).¹ Matcha tea, a form of green tea, consists of finely ground, processed green tea leaves,² is widely consumed in Japan as a beverage or as a popular ingredient in snacks. Recent studies have shown that epigallocatechin gallate (EGCg), a major, low-molecular weight polyphenol in green tea leaves, has beneficial health effects, including anti-inflammatory, antiarthritic, antioxidative, antibacterial, and antiviral activity. These health benefits are contributing to the current rise in the popularity of green tea and related products.³ Although seldom reported, hypersensitivity reactions to green tea are known to occur. Herein, we reported a male, pediatric patient in Japan who experienced anaphylaxis after consuming green tea, which was later confirmed by oral food challenge (OFC). Informed consent to publish the details of the case was obtained from the legal guardians of the patient.

A 9-year-old, male patient presented at the emergency room with cough and itching over the entire body 60 min after ingesting matcha tea-flavored ice cream. He had nausea, systemic erythema/hives, low blood pressure (74/52 mmHg) and tachycardia (100/min). Anaphylactic shock was diagnosed, and the patient was treated with intramuscular adrenaline, intravenous hydration, and steroid. The symptoms improved by the following day. The patient had no history of allergic reaction either to dairy products or to green tea although he had never drunk matcha tea, black tea or oolong tea. He had no other past medical history, including allergic diseases, such as asthma, atopic dermatitis, and allergic rhinitis. His parents had hay fever but no history of other allergic diseases nor did any work involving green tea. However, his mother routinely drank a cup of powdered green tea every day.

After discharge, further testing was done to determine the causative antigen. Based on his medical history, matcha tea, one of the ingredients of the ice cream he ate, was suspected of being the causative antigen. A prick-by-prick test with the ice cream was negative, but matcha tea produced wheals around 3 mm in diameter. Caffeine 0.5 mg/mL, 5 mg/mL and 50 mg/mL was negative. Saline was negative, and histamine elicited wheals about 5 mm in diameter. The level of green tea (*Camellia sinensis*; f222)-specific IgE was 0.105 UA/mL (ImmunoCAP, ThermoFisher Scientific).

After obtaining the patient's written informed consent, an oral food challenge (OFC) was performed after admission. The amount of matcha in matcha-flavored ice cream was estimated to be 3 g, including approximately 55 mg of matcha proteins, equivalent to

the quantity in about 1.5–2 cups of matcha tea. First, an OFC was performed with the brand of matcha tea-flavored ice cream that was suspected of producing the anaphylactic episode. The OFC was planned with 50 and 150 g with a 60-min interval but second dose was not administered because 60 min after consuming the first dose of 50 g, the patient experienced systemic erythema/hives and cough/wheeze. A second OFC was performed with 2.0 g of matcha tea in a single dose containing approximately 37 mg of matcha proteins. Sixty minutes thereafter, the same symptoms appeared. A third OFC performed with 90 mg of anhydrous caffeine given in two doses of 30 and 60 mg with a 60-min interval elicited no allergic reaction developed. The final OFC, performed with a catechin tablet containing 160 mg of EGCg and 22 mg of epigallocatechin (EGC), was administered in a single dose and but also likewise elicited no allergic reaction.

Based on the OFC findings, IgE-mediated green tea allergy unrelated to caffeine or catechins was diagnosed. IgE immunoblotting using green tea protein extract revealed bands of approximately 60-kDa and 100 to 150-kDa only in the patient's sera (Fig. 1). The patient was instructed to refrain from consuming any foods containing *Camellia sinensis*, including matcha tea, green tea, black tea, and oolong tea, and to carry antihistamines and adrenaline auto-injectors in case any allergic symptoms occurred.

Green tea allergy often occurs during occupational exposure to the antigen.^{4,5} In a case series including 11 workers at a green tea processing plant with the diagnosis of asthma caused by EGCg, five experienced respiratory symptoms after consuming tea.⁵ Meanwhile, green tea allergy was also reported in two patients with no history of occupational exposure to the substance.^{6,7} Both patients initially experienced an allergic reaction after drinking green tea. The results of a specific IgE test (f222) in both patients were negative for green tea, but a skin prick test (SPT) with green tea was positive,^{6,7} and IgE immunoblotting using green tea extract in one of the patients revealed the presence of a band between 75-kDa and 50-kDa, and a blurred high molecular band.⁷ Although the level of tea-specific IgE antibodies in the present case was low, the SPT with green tea was positive, and a test using green tea extract found IgE antibody-reactive 60-kDa and 100 to 150-kDa proteins. Although the molecular band mentioned above was very blurred, it might have indicated the same protein as that identified in the previous report. While the findings of the present and previous reports suggested that green tea might contain certain proteins to which the IgE antibody reacts, the diagnostic utility of green tea (f222)-specific IgE antibody testing for green tea allergy is apparently poor. Proteins account for approximately 15% of the dry weight of tea leaves, but no detailed study of green tea proteins has yet been made.⁸ Research to develop a blood test for diagnosing green tea allergy is warranted.

Peer review under responsibility of Japanese Society of Allergy.

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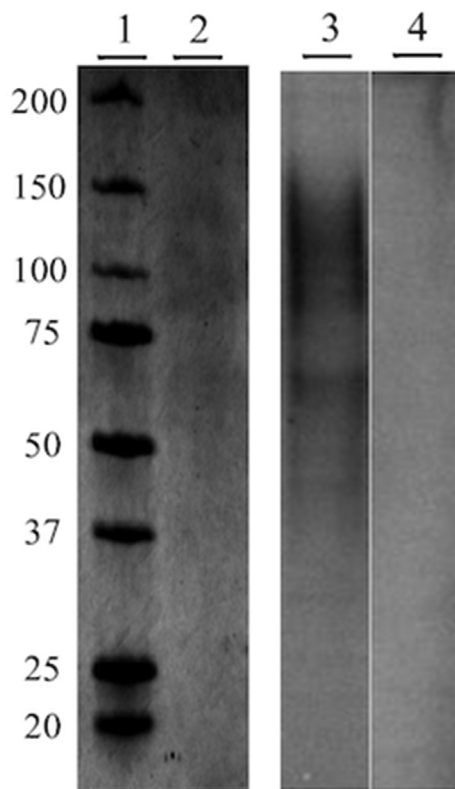


Fig. 1. IgE immunoblotting of the green tea extracts. Lane 1, color marker. Lane 2, CBB staining with the green tea extract. Lane 3, the green tea extract+patient serum. Lane 4, the green tea extract+control serum. Molecular weight markers are indicated on the left (20, 25, 37, 50, 75, 100, 150 and 200 kDa).

Based on currently available data, green tea allergy may be divided into at least two types depending on whether the causative antigen is the protein or the catechins contained in *Camellia sinensis*. Moreover, because green tea contains a large quantity of caffeine and there have been reports of caffeine-induced anaphylaxis or hypersensitivity,^{9,10} caffeine allergy should also be considered. Because catechins and caffeine occur in a wide variety of foods besides green tea, physicians should determine the causative allergen and provide dietary advice to patients with green tea allergy.

In conclusion, we described a case of anaphylactic shock in a child who ingested a food item containing matcha tea. To the best of our knowledge, there are currently no other reports of pediatric cases of green tea allergy diagnosed by OFC. The patient's mother drank green tea every day, which may have created a sensitizing environment. Matcha contains much more proteins than other types of green tea beverage, which might cause IgE-mediated food allergy in our patient. The present case demonstrated that green

tea especially matcha, which is being used increasingly in various food products, has the potential to cause life-threatening allergic reactions in children.

Acknowledgements

We are indebted to Mr. James R. Valera for his critical reading of the manuscript.

Conflict of interest

The authors have no conflict of interest to declare.

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Received 10 March 2021

Received in revised form 27 May 2021

Accepted 29 May 2021

Available online xxx