

CASE REPORT

Fatal Buckwheat Dependent Exercised-Induced Anaphylaxis

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Anaphylaxis induced by physical stimulus immediately following a meal is called food-dependent exercise-induced anaphylaxis (FEA).^{1,2} This incidence of FEA among Japanese kindergartener, elementary and junior high schoolchildren is 0, 0.06, and 0.21% among allergic diseases, respectively.² Buckwheat (*Fagopyrum esculentum*, Moench) allergy was reported by Smith in 1909.³ It is known that severe allergic symptoms are provoked by the consumption or inhalation of a minute quantity of the putative antigen.^{3,4} Food items such as shrimp and wheat have been named as those responsible for the development of FEA¹ but those caused by buckwheat have been rare. We present the clinical laboratory and autopsy findings from the first reported case of life-threatening FEA by buckwheat, which occurred in an 8-year-old girl with bronchial asthma.

CASE REPORT

The patient is an 8-year old girl with a history of atopic

SUMMARY Cases of food-dependent exercise-induced anaphylaxis (FEA) caused by buckwheat have been rare. Clinical, laboratory, and autopsy findings are present on an 8-year old girl with FEA caused by Japanese buckwheat. The patient consumed buckwheat noodles called "zaru soba" and immediately thereafter swam vigorously. Approximately 30 minutes later, she complained of abdominal pain, vomiting, coughing, and chest discomfort. Another ten minutes later her consciousness level deteriorated and she experienced cardiorespiratory arrest. The heart beat was restored and she was admitted to the hospital. She never regained consciousness and expired after another arrest 13 days later. Her IgE level was high (2,840 IU/ml) and the IgE-radioallergosorbent test (RAST) score was 2 for soybeans, 3 for buckwheat, 2 for rice, and 3 for wheat. An exaggerated hematemesi that occurred immediately after hospital admission indicated an inflammatory condition of the digestive tract that was caused by buckwheat. Marked ulceration accompanied with hemorrhage and necrosis was noted at the ileum. Extensive hemorrhage involving the endotracheal pulmonary field and lymphocyte infiltration of the alveolar space likely appeared after the inflammation. The analysis of buckwheat-specific IgE antibody by immunoblotting showed 7 bands that reacted with the IgE of the patient's serum, 4 bands: 16, 20, 24, and 58 kDa, were specific to the patient as compared to subjects not allergic to buckwheat. A first case of fatal FEA by buckwheat is reported with reference to specific IgE.

dermatitis and asthma. She was visiting a public pool near our hospital. For lunch, she consumed one-half of a package of buckwheat noodles that had been purchased at a local convenience store. She started to swim vigorously immediately afterward, swimming approximately 50 meters as fast as possible. Within 30 minutes fol-

lowing lunch, she complained of abdominal pain, and vomited. She also complained of thoracic pain and coughing. Ten minutes later she was brought to our ambulatory

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department hypothermic, in respiratory arrest with no pulse. She appeared pale, her eyes were fixated at the median position with dilated pupils. The abdomen was distended. The skin was marked with eczema (atopic dermatitis) and hives but eruptions suggestive of viral infections such as measles were absent. Cardiopulmonary resuscitation was applied immediately after admission and respiratory care was administered by tracheal intubation and artificial respiration, which resulted in a return of the heart beats. Laboratory tests on admission revealed hypoproteinemia, hypoalbuminemia, hypernatremia, and hyperphosphatemia. Three hours after admission, the patient passed a massive quantity of blood per rectum and developed urinary retention. The electroencephalographic waves were no longer detected and the auditory-evoked brain stem potentials were absent. On the 13th day of hospitalization, her blood pressure dropped with subsequent cardiac arrest. The patient expired in spite cardiopulmonary resuscitation efforts. Autopsy findings of alveolar hemorrhage was noted. The bronchial lesions were mild with slight lymphocyte infiltration and fibrin thrombosis of the pulmonary microvessels. An examination of the intestines revealed a round ulcer at the upper ileum opposite the mesentery (Fig. 1a). The intestinal wall at the ulcerous region was perforated with hemorrhagic necrosis. At the base of the ulcerous lesion, completely thrombosed blood vessels with necrotic lumen were noted (Fig. 1b).

Test for IgE antibody

The IgE level was high (2,840 IU/ml). The IgE-RAST scores were 3 for buckwheat, 3 for

wheat, 2 for soybeans and 2 for rice (range of the score: 0 to 4). The lymphocyte antigen-specific IL-2 response test^{5,6} was conducted but the results were all negative for the antigens tested (at steroid administration). The result of prick tests using buckwheat, wheat, soybeans

and rice as an antigens was also negative (during steroid administration at test).

Immunoblotting⁷ was conducted to analyze the buckwheat antigen-specific IgE antibody of the patient's serum. The buckwheat

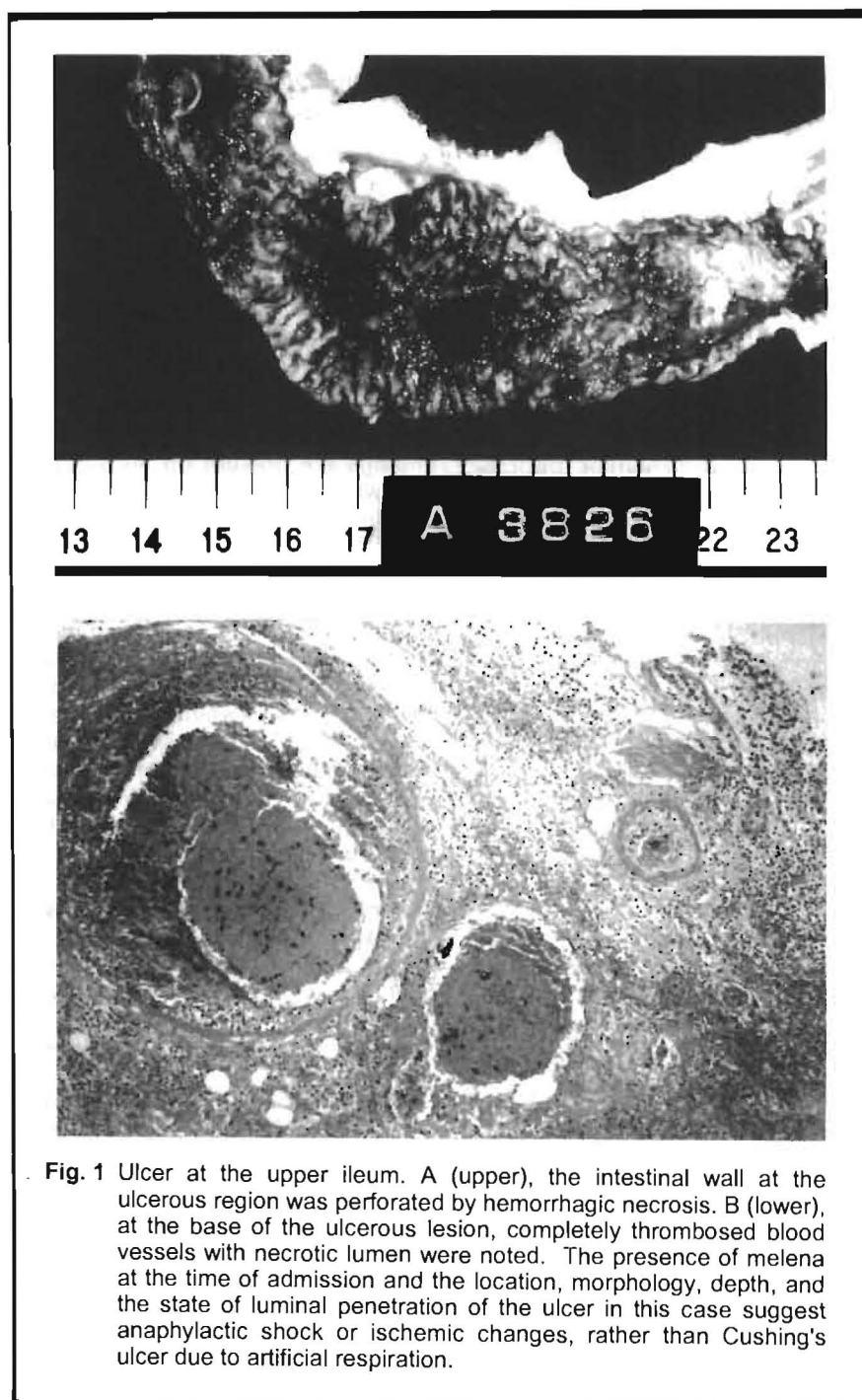


Fig. 1 Ulcer at the upper ileum. A (upper), the intestinal wall at the ulcerous region was perforated by hemorrhagic necrosis. B (lower), at the base of the ulcerous lesion, completely thrombosed blood vessels with necrotic lumen were noted. The presence of melena at the time of admission and the location, morphology, depth, and the state of luminal penetration of the ulcer in this case suggest anaphylactic shock or ischemic changes, rather than Cushing's ulcer due to artificial respiration.

proteins existed in a wide range of molecular weight, i.e. 14 to 100 kDa, in a fraction of SDS-PAGE; but according to immunoblotting, about 7 bands reacted with the IgE of the patient's serum. Among them, 4 bands, namely, 58, 24, 20, and 16 kDa were detected only by the patient's serum, whereas, the remaining bands were also revealed by sera of 4 allergic patients not allergic to buckwheat including patients with bronchial asthma and allergic rhinitis.

DISCUSSION

The patient and her family did not usually consume Japanese buckwheat noodles. But occasionally the noodles were offered at friends' homes, and if she consumed a little, she suffered no symptoms such as nausea. More frequently, she would turn them down. At the occasion described here, she was with other children who insisted on buying the packaged buckwheat noodles at a convenience store for lunch and she went along with them. She only consumed one-half of the serving, then engaged in strenuous swimming activities immediately after lunch. Approximately 30 minutes later, she developed gastrointestinal symptoms, such as abdominal pain, together with coughing and thoracic pain, which culminated in cardiac arrest 30 minutes later. Buckwheat noodles were the only food that she consumed at lunch, then engaged in strenuous exercise in the form of swimming. We tend to believe that she suffered from food-dependent, exercise-induced anaphylactic shock due to buckwheat. Her IgE RAST score for wheat was 3 but she did not consume wheat in the current episode. Soy sauce was included in the buckwheat noodle dish. Her soybean RAST score was

2 and the possibility of a shock due to soybean antigen cannot be totally negated. However, soybean products are liberally used in school lunches and on other occasions and she had been consuming them without restrictions and experienced no symptoms in spite of participating in physical activities immediately after mealtime. Therefore we tend to negate the theory of anaphylactic shock due to soybean consumption.

The massive melena immediately after admission is suggestive of inflammation of the digestive system that was caused by buckwheat. The autopsy findings: the ileum exhibited an eminent ulcerous state with hemorrhage and necrosis. There is a possibility that the use of steroids during resuscitation attempt, succeeding care given for about 10 days, exaggerated stress that existed in the hospitalized patient may be incriminated as factors for the development of the ulcer, or the patient's gastrointestinal symptoms, and events may have been due to ischemia secondary to her cardiopulmonary arrest. However, the allergic symptoms associated with the oral consumption of buckwheat include: aberrant oral sensation, stenotic sensation, oral and labial edema, allergic rhinitis, conjunctivitis-like symptoms, coughing, wheezing, sensation of thoracic compression, systemic urticaria, itching, burning sensation, pain of the upper abdominal region, nausea, vomiting, diarrhea, and anaphylactic shock. The present patient experienced hives, coughing, gastrointestinal symptoms, thoracic discomfort, and anaphylactic shock. These findings were amply explained by the anaphylaxis theory.

Extensive hemorrhage in-

volving the pulmonary field and the endotracheal region and lymphocyte infiltration of the pulmonary interstitium were likely caused by the anaphylaxis and subsequently derived allergic inflammations.

To verify an antigen responsible for the anaphylaxis, the lymphocyte response to allergens and prick test was conducted but unfortunately the results were all negative for the antigens tested, probably due to steroid administration at test. However, we detected IgE specific to buckwheat in the patient's serum, and not in 4 patients not allergic to buckwheat. The IgEs reacted with the buckwheat antigen of molecular weights of 16, 20, 24, and 58 kDa were identified to be those specific to the patient. It is not certain which of these components was(were) involved in the present pathophysiological process in the patient. According to the intradermal tests or RAST inhibition test, however, it was reported that the molecular weights of the buckwheat antigens that may be responsible for anaphylaxis were 17, 50, 108,⁸ and 24 kDa are frequently found in immunoblotting analysis.⁷ The molecular weights of all buckwheat components that reacted with the patient's IgEs that we identified were found to be close to these values.

REFERENCES

1. Dohi M, Suko M, Sugiyama H *et al.* Food-dependent, exercise-induced anaphylaxis: a study on 11 Japanese cases. *J Allergy Clin Immunol* 1991; 87: 34-40.
2. Tanaka S. An epidemiological survey on food-dependent exercise-induced anaphylaxis in kindergartners, school-children and junior high school students. *Asia Pac J Public Health* 1994; 7: 26-30.
3. Gohte CJ, Wieslander G, Ancker K, Forsbeck M. Buckwheat allergy: health

- food, an inhalation health risk. *Allergy* 1983; 38: 155-9.
4. Davidson AE, Passero MA, Setticone GA. Buckwheat-induced anaphylaxis: a case report. *Ann Allergy* 1992; 69: 439-40.
 5. Noma T, Yoshizawa I, Kou K *et al.* Pattern of cytokine production by T cells from adolescents with asthma in remission, after stimulation with *Dermatophagoides farinae* antigen. *Pediatr Res* 1995; 38: 187-93.
 6. Noma T, Yoshizawa I, Kou K *et al.* Correlation of interleukin-2 (IL-2) responsiveness by egg white-stimulated lymphocytes with hen egg oral provocation test in atopic children. *Arerugi Japanese J Allergol* 1996; 45: 660-71.
 7. Kondo Y, Urisu A, Wada E *et al.* Allergen analysis of buckwheat by the immunoblotting method. *Arerugi* 1993; 42: 142-8.
 8. Yanagihara Y, Nakajima K. Buckwheat hypersensitivity. *Arerugi* 1978; 27: 134-7.