



## Wheat – Dependent Exercise-Induced Anaphylaxis Occurred With a Delayed Onset of 10 to 24 hours After Wheat Ingestion: A Case Report

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Wheat-dependent exercise-induced anaphylaxis (WDEIA) usually occurs 1 to 4 hours after wheat ingestion and the pathophysiology of WDEIA remains unknown. It is recommended that WDEIA patients refrain from exercise for 4 to 6 hours after wheat ingestion. We report a case of a 51-year-old man who experienced 5 anaphylaxis attacks; two of which occurred 10 to 24 hours after wheat ingestion and exercise. He has a history of chronic gastroenteritis that responds well to antihistamine drugs but not proton pump inhibitors (PPIs) and prokinetic agents. Abdominal CT results implied the possibility of superior mesenteric artery syndrome. We suggest that WDEIA occurs 6 hours after wheat ingestion in cases compounded by obstructive gastrointestinal diseases.

**Key Words:** Wheat-dependent exercise-induced anaphylaxis; chronic gastroenteritis; superior mesenteric artery syndrome

### INTRODUCTION

Wheat-dependent exercise-induced anaphylaxis (WDEIA) is a rare but potentially severe food allergy characterized by anaphylactic reactions that range from urticaria to respiratory, gastrointestinal or cardiovascular symptoms that occur 1 to 4 hours after the ingestion of wheat, followed by physical exercise.<sup>1</sup> Wheat allergens (especially omega-5 gliadin) play an important role in the elicitation of WDEIA.<sup>2</sup> Cofactors such as aspirin, alcohol intake, infections, stress or female sex hormones/menstruation can substitute for or synergize with exercise to instigate the immediate-type hypersensitivity reaction after the ingestion of wheat.<sup>3</sup> We present an unusual case of a 51-year-old patient who developed exercise-induced anaphylaxis with a 10 to 24 hour delayed onset after wheat ingestion.

### CASE DESCRIPTION

A 51-year-old patient presented to our department complaining of generalized urticaria, itching, dyspnea and dizziness that was preceded 30 minutes earlier by a Chinese wheaten-based pancake followed by walking. He recovered 2 hours after the oral administration of 10 mg cetirizine. He had previously experienced 2 other outbreaks of anaphylactic reactions with similar clinical findings about 1 hour after the ingestion of wheaten food.

He had experienced 2 other outbreaks within a 4-month interval with severe anaphylactic reactions delayed to 10 and 24 hours after the ingestion of wheaten food. The first attack occurred 24 hours after wheat ingestion. The patient awoke at 7am and 15 minutes later (without having breakfast) he felt itchy, chest tightness, generalized urticaria and fell unconsciousness during showering. He had consumed noodles for breakfast the previous day and only rice porridge and pickled radish for dinner due to abdominal distension and nausea. On the second attack (before hospitalized for chronic gastroenteritis), he only ate some wheat biscuits at 10 am. At 8pm (about 10 hours after wheat ingestion) he experienced generalized urticaria and syncope during walking.

The patient had had a 20-year history of chronic gastroenteritis manifested by vomiting, abdominal pain and distension that was unresponsive to H2 antagonists, PPIs and prokinetic agents. He was instructed to take digestible food (such as noodles and porridge); however, the digestive symptoms still occurred with

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periodical abdominal distention and vomit. Interestingly, cetirizine dramatically alleviated his digestive symptoms; in addition, no anaphylactic reactions were experienced if he consumed wheaten food without exercise.

A skin prick test showed positive results to dust mite, shrimp and crab (wheal  $\geq 5$  mm), but the patient could tolerate these foods. Prick to prick reactions to wheat allergens were strongly positive (salt soluble wheal 11 mm  $\times$  9 mm, salt insoluble wheal 15 mm  $\times$  12 mm). The levels of serum specific IgE to wheat, gluten and omega-5 gliadin were 0.87 KUA/L, 3.18 KUA/L and 7.16 KUA/L respectively. A gastroscopy indicated erosive gastritis and duodenal bulbar inflammation; addition, biopsy pathology indicated chronic nonspecific inflammation with no eosinophil infiltration. The patient had experienced anaphylaxis 5 times; subsequently, oral challenge tests were not performed. After 3 months of a strict wheat-free diet, he had no anaphylaxis attack and his digestive symptoms were alleviated significantly but did not disappear. An abdominal CT scan and a 3-D reconstruction indicated a compression and squash on the posterior horizontal duodenum, expansion on the anterior horizontal duodenum and a slightly narrowed mesenteric angle.

## DISCUSSION

Food - dependent exercise - induced anaphylaxis (FDEIA) is a rare and potentially fatal food allergy characterized by the onset of exercise-related anaphylaxis during or soon after food ingestion. Various foods (such as celery, wheat, shellfish, grapes, and nuts) are reported to predispose the development of FDEIA.<sup>4</sup> In Japan, the most frequent causative food of FDEIA is wheat.<sup>5</sup> Many exercises of different intensity can trigger anaphylaxis; however, moderate and mild exercise can result in the same consequences.<sup>6</sup>

Wheat allergens include water/salt soluble proteins (such as albumins and globulin) and water/salt insoluble proteins (such as gliadin and gluten). Research has recently indicated that wheat omega-5 gliadin and high molecular weight-gluten subunit are major allergens for WDEIA.<sup>7</sup> The proteins are very stable even after prolonged hydrolyzation and can retain the ability to activate mast cells in hydrolyzed wheat proteins (HWP1)-sensitized subjects.<sup>8</sup>

The pathophysiology of FDEIA is unclear. Increased plasma histamine has been documented during FDEIA attacks. The factors that cause mast cells and basophils to release histamines include increased gastrointestinal permeability, blood flow redistribution, and increased osmolality. Data from recent investigations indicate that the cascade of events that result in FDEIA symptoms are triggered in the intestine.<sup>9</sup> It has been demonstrated that gliadin appears in sera from WDEIA patients and healthy controls after an exercise/food challenge, but not after food ingestion alone.<sup>10</sup>

In most cases, anaphylactic reactions occur 1 to 4 hours after

wheat ingestion and exercise because food ingredients are usually absorbed into blood within 4 hours after ingestion. Oyefara BI *et al.* reported a patient who experienced anaphylaxis 5 hours after exercise that followed wheat ingestion.<sup>11</sup> WDEIA patients are generally advised to avoid wheat ingestion or avoid exercise 6 hours after wheat ingestion.

Here we report a case of WDEIA attack that occurred 10 to 24 hours after wheat ingestion. The precise mechanism underlying the delayed onset of symptoms in our patient is unknown; consequently, an isolated late-phase response or delayed gastric emptying is a possibility. The patient had a 20-year history of chronic gastroenteritis and with no response to PPIs and prokinetic agents, but a good response to anti-histamine agents. This implied an allergic component may have been involved and wheat may have been an important trigger factor of chronic gastroenteritis, but the patient did not stop taking wheat until the final diagnosis was confirmed. Persistent allergic inflammation occurred in the digestive tract causing the congestion and edema of gastrointestinal tract mucosa with an increased gastrointestinal permeability that resulted in the abdominal distension, vomiting, and weight loss. Chronic inflammation also facilitated the transfer of wheat allergens from the bowel to blood. The indigestive symptoms of these 2 delayed episodes were extremely severe, which might further increase gastrointestinal permeability and the potential of an anaphylaxis incident due to minor exercise. An abdominal CT scan and 3-D reconstruction showed a compressed and squashed posterior horizontal duodenum, expanding anterior part of horizontal portion and slightly narrowed mesenteric angle, which implied the possibility of superior mesenteric artery syndrome. This syndrome can cause the prolongation of gastric emptying. Both chronic gastrointestinal inflammation and prolonged gastric emptying might explain the development of symptoms 10 to 24 hours after wheat ingestion.

This case indicated that WDEIA might occur 6 hours after food ingestion especially in patients whose illness was compounded by obstructive gastrointestinal diseases. Delayed reactions may occur several hours after food ingestion and can be life-threatening; therefore, patients should be advised to avoid wheat ingestion or avoid exercise for more than 6 hours after eating wheaten food.

## REFERENCES

1. NIAID-Sponsored Expert Panel, Boyce JA, Assa'ad A, Burks AW, Jones SM, Sampson HA, Wood RA, Plaut M, Cooper SF, Fenton MJ, Arshad SH, Bahna SL, Beck LA, Byrd-Bredbenner C, Camargo CA Jr, Eichenfield L, Furuta GT, Hanifin JM, Jones C, Kraft M, Levy BD, Lieberman P, Luccioli S, McCall KM, Schneider LC, Simon RA, Simons FE, Teach SJ, Yawn BP, Schwaminger JM. Guidelines for the diagnosis and management of food allergy in the United States: report of the NIAID-sponsored expert panel. *J Allergy Clin Immunol* 2010;126:S1-58.

2. Morita E, Matsuo H, Chinuki Y, Takahashi H, Dahlström J, Tanaka A. Food-dependent exercise-induced anaphylaxis -importance of omega-5 gliadin and HMW-glutenin as causative antigens for wheat-dependent exercise-induced anaphylaxis. *Allergol Int* 2009;58:493-8.
3. Fischer J, Schuck E, Biedermann T. Wheat-dependent exercise-induced anaphylaxis exclusively during menstruation. *Allergy* 2010;65:1347-8.
4. Povesi Dascola C, Caffarelli C. Exercise-induced anaphylaxis: a clinical view. *Ital J Pediatr* 2012;38:43.
5. Dohi M, Suko M, Sugiyama H, Yamashita N, Tadokoro K, Juji F, Okudaira H, Sano Y, Ito K, Miyamoto T. Food-dependent, exercise-induced anaphylaxis: a study on 11 Japanese cases. *J Allergy Clin Immunol* 1991;87:34-40.
6. Yin J, Wen L. Wheat-dependent exercise-induced anaphylaxis clinical and laboratory findings in 15 cases. *Chin J Allergy Clin Immunol* 2010;4:26-32.
7. Matsuo H, Kohno K, Niihara H, Morita E. Specific IgE determination to epitope peptides of omega-5 gliadin and high molecular weight glutenin subunit is a useful tool for diagnosis of wheat-dependent exercise-induced anaphylaxis. *J Immunol* 2005;175:8116-22.
8. Nakamura R, Nakamura R, Adachi R, Itagaki Y, Fukutomi Y, Teshima R. Evaluation of allergenicity of acid-hydrolyzed wheat protein using an in vitro elicitation test. *Int Arch Allergy Immunol* 2013;160:259-64.
9. Barg W, Medrala W, Wolanczyk-Medrala A. Exercise-induced anaphylaxis: an update on diagnosis and treatment. *Curr Allergy Asthma Rep* 2011;11:45-51.
10. Matsuo H, Morimoto K, Akaki T, Kaneko S, Kusatake K, Kuroda T, Niihara H, Hide M, Morita E. Exercise and aspirin increase levels of circulating gliadin peptides in patients with wheat-dependent exercise-induced anaphylaxis. *Clin Exp Allergy* 2005;35:461-6.
11. Oyefara BI, Bahna SL. Delayed food-dependent, exercise-induced anaphylaxis. *Allergy Asthma Proc* 2007;28:64-6.