

Respiratory pathophysiologic responses

Reduced pulmonary function in multiple food-induced, exercise-related episodes of anaphylaxis

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Exercise-induced anaphylaxis (EIA) is a distinct form of physical allergy.¹ Food intake has been reported as a precipitating factor of EIA.²⁻⁵ EIA after the ingestion of a meal² or of a single food³ has been reproduced by challenges. Furthermore, patients with a history of EIA induced by multiple foods have been described.^{4,5}

We present two patients in whom the separate ingestion of different foods triggered the occurrence of symptoms after exercise challenge.

METHODS

Case reports

Patient 1. A 19-year-old girl had experienced, for 2 years, several episodes of urticaria, angioedema, swelling of the tongue, and rhinoconjunctivitis after dancing or playing basketball for 10 minutes, if the physical activity was preceded by food ingestion. Among foods taken before exercise, maize, peas, soy, rice, tomato, wheat, peach, and apple were believed to be triggering factors. She had no personal history of atopy. Her brother had seasonal rhinoconjunctivitis.

Patient 2. A 19-year-old boy had had two episodes of anaphylaxis in the last 2 months after playing basketball for 30 minutes. He had pruritus of the palms, which progressed to urticaria, angioedema, conjunctivitis, dyspnea, hypotension, and eventually loss of consciousness. These episodes were preceded by ingestion of potato, peanuts, wheat, or rabbit meat 60 minutes before exercise. Tomato and peas were considered potential precipitating foods because the patient disliked and rarely ate them. He and his father complained of grass pollen-induced asthma and rhinoconjunctivitis.

Both patients had no family history of EIA. The patients

Abbreviation used

EIA: Exercised-induced anaphylaxis

did not experience anaphylaxis after ingestion of suspected foods not followed by exercise; after similar exercise without food ingestion; in response to warm baths, fever, or other increases in core body temperature; or in response to drug intake, weather conditions, or menstrual cycle. The relevance of dental amalgam was not noted.

Immunologic studies

Patients underwent skin prick tests with food extracts (1:20 wt/vol) (Bayropharm, Milan, Italy), histamine (1 mg/ml), and the diluent. Blood samples were obtained to measure both specific IgE antibodies to food by RAST (Pharmacia, Uppsala, Sweden) and total IgE levels by PRIST (Pharmacia).

Exercise challenges

Patients underwent exercise tests after 12 hours of fasting, 1 hour after a meal without suspected foods, and 1 hour after eating each suspected food. As a control, five healthy subjects performed exercise challenges both after fasting and 1 hour after a meal. Exercise challenges were performed on separate days.

The exercise test consisted of indoor free running for 6 minutes, leading to a heart rate of at least 170 beats/min. Pulmonary function was measured with a computerized spirometer (Microloop-Markos, Monza, Italy) before running and at 3-, 6-, 10-, and 15-minute intervals after beginning the exercise. Postexercise values of peak expiratory flow rate and FEV₁ were expressed in absolute values and as percentage changes from baseline at individual time points. Maximum percentage falls were calculated as follows: $100 \times (\text{Preexercise value} - \text{Lowest value after exercise}) \div \text{Preexercise value}$. Exercise test was considered positive for bronchospasm if it caused a maximum fall of peak expiratory flow rate greater than 12% or a maximum fall of FEV₁ greater than 10%.

Blood pressure was monitored before and after exercise challenge and during reactions.

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TABLE I. Results of immunologic studies and food-exercise combination challenges

Patient No.	Food	SPT result	RAST (class)	IgE (IU/ml)	Exercise challenge		
					Time between end of exercise and symptoms	Prodromal manifestation	Complete clinical symptoms
1	Peach	+	0	104		Negative	Negative
	Apple	—	4			Negative	Negative
	Rice	+	3			Negative	Negative
	Soy	—	2			Negative	Negative
	Maize	+	3			Negative	Negative
	Peas	+	3			Negative	Negative
	Tomato	+	2		5 min	Palm pruritus	Rhinoconjunctivitis, generalized urticaria, facial angioedema, & swelling of mouth
	Wheat	+	2	5 min	Palm pruritus	Rhinoconjunctivitis, generalized urticaria, facial angioedema, & swelling of mouth	
2	Potato	+	3	1399	1 min	Palm and leg pruritus	Conjunctivitis, lump in the throat, inspiratory dyspnea, generalized urticaria, & lip angioedema
	Peanuts	+	3		1 min	Palm pruritus	Generalized urticaria, lip angioedema, & dyspnea
	Tomato	+	3		1 min	Diffuse pruritus	Generalized urticaria
		+			4 hr		Wheezing
	Wheat	+	3			Negative	Negative
	Peas	+	4			Negative	Negative
	Rabbit meat	+	0			Negative	Negative

SPT, Skin prick test.

RESULTS

In control subjects, exercise challenges provoked neither symptoms nor significant changes in pulmonary function. In patient 1, two of eight food-exercise combination challenges were positive; in patient 2, three of seven (Table I). No reaction was provoked by challenges performed after fasting or after a meal without suspected foods.

Airway obstruction was registered on pulmonary function testing after positive challenges (Fig. 1). In patient 2, wheezing occurred 4 hours after tomato-exercise challenge. No other food was eaten during this period (Fig. 1).

After challenges, blood pressure did not fall below resting values. Patients were successfully treated with antihistamines, corticosteroids, epinephrine, and inhaled salbutamol. Results of skin prick tests and RASTs with precipitating foods were positive (Table I).

DISCUSSION

This study shows that pulmonary function is reduced in patients with multiple food-dependent EIA. Positive exercise challenges, in fact, were associated with airflow obstruction not only in patients with dyspnea but also in patients without respiratory symptoms.

Maulitz et al.⁴ described a patient with a history of shellfish-dependent EIA. A questionnaire survey of subjects with probable EIA showed that intake of specific foods precipitated attacks in the majority of patients.⁵

In our patients, history was helpful in indicating foods which could be suspected of favoring the reaction. The identification of triggering foods was always made by results of challenge tests.

The pathogenetic mechanisms of food-dependent EIA remain unclear. Our patients had atopic background in addition to an *in vivo* and *in vitro* immediate hypersensitivity reaction to foods.^{3,4} These

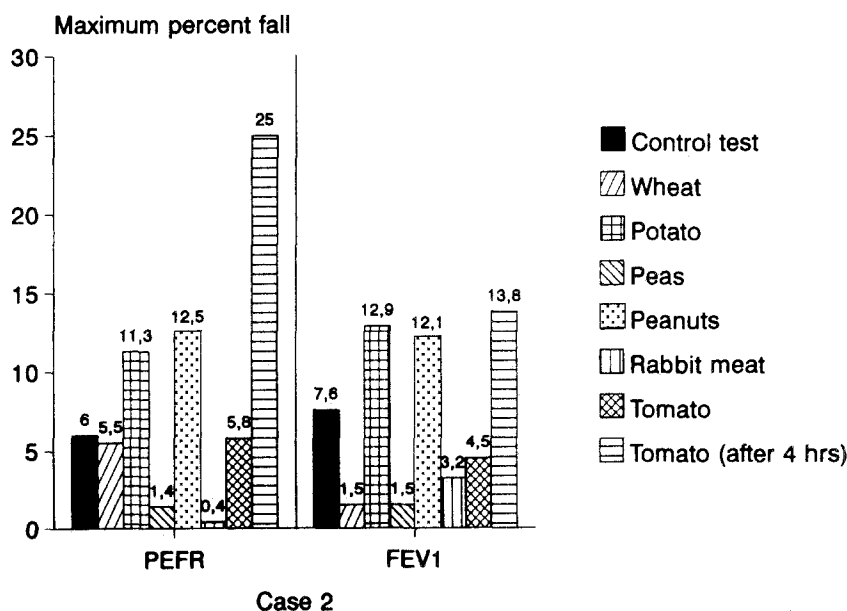
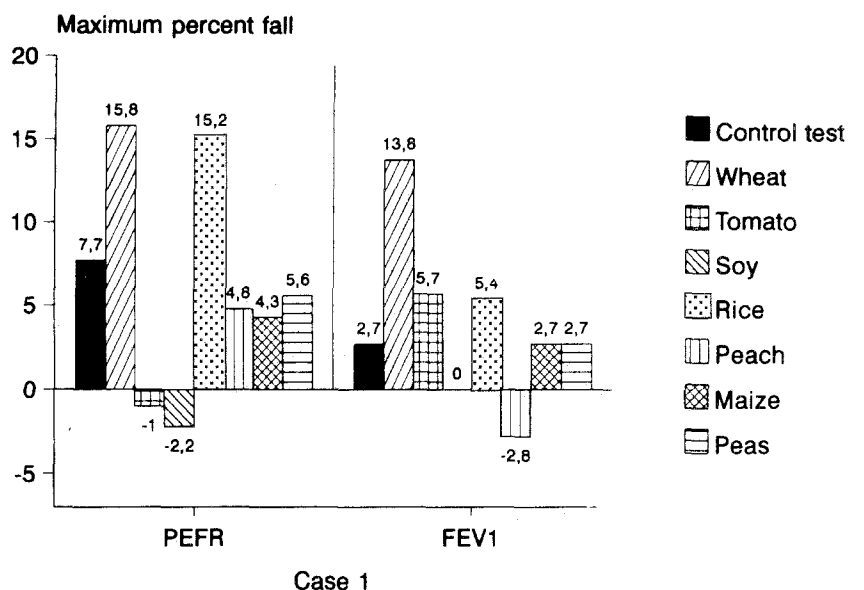


FIG. 1. Maximum percent fall in peak expiratory flow rate and FEV₁ for each food-exercise combination challenge.

findings support the hypothesis that a food-dependent IgE-mediated reaction enhances mediator release from mast cells induced by exercise.^{3,4} Furthermore, in patient 2, the delayed onset of wheezing was probably caused by a late-phase allergic reaction.

In conclusion, an accurate diagnosis is recommended in patients with EIA to avoid unnecessary diet restriction and to prevent serious reactions. Although food-exercise combined challenge is

time-consuming and potentially hazardous, our findings suggest that it may be helpful in identifying foods that trigger the reactions.

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