

Report

Anaphylactic reaction to apple, banana and lychee: what is common between botanically disparate plant families?

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We present the case of a 33-year-old nonatopic woman with multiple episodes of anaphylaxis after ingestion of different fruits. The fruits implicated were apple, banana and lychee: all of which belong to different and botanically disparate plant families. The reaction to apple and banana was confirmed by prick testing. There was no history of allergy to other agents that are known to have cross reactions with fruits, viz. latex or pollen. As such patients often do not present to dermatologists, we wish to highlight the rare but potentially fatal clinical entity of type I allergy to fruits without concomitant allergy to other common airborne/contact allergens. We also discuss the possible explanation of type I reaction to apparently unrelated fruits and the allergens involved in such reactions.

Introduction

Anaphylaxis is a rare, generalized and potentially fatal clinical syndrome resulting from the release of biologically active mediators from mast cells and basophils. Although food allergies are common causes of anaphylaxis,¹ fruits are relatively rarely implicated, ranking well below eggs, milk, crustaceans and fish.² Patients showing type I reactions to a particular fruit often cross-react to other fruits of the same family, e.g. patients allergic to apples are at a high risk of reacting to other fruits of the Rosaceae family like peach, plum and apricot etc.³ However, some patients have been known to react to widely different plant foods of unrelated families.^{4,5} Recently, we came across a similar patient who had several episodes of life-threatening reactions to apparently unrelated fruits. We present this case with a brief overview of the current understanding of such reactions.

Case Report

A 33-year-old housewife presented with a history of severe reactions to certain fruits for the past 5 years. The first episode occurred 5 years ago when minutes after eating an apple, she became breathless and developed widespread wheals. Respiratory arrest followed, but she was revived after injections of epinephrine and antihistamines at a nearby hospital. Two years later, a similar but milder reaction occurred after she ate a banana. This time, she had extensive whealing, dyspnea and tongue edema, but no respiratory arrest. The symptoms were controlled with emergency treatment in a hospital.

She avoided all fruits for the next 3 years during which she was symptom free.

A few months before presenting to us, she ate a lychee-fruit upon reassurance by her family physician that it was unlikely to cause any problem. Severe urticaria, angioedema of the eyelids and mild wheezing followed for which she had to be given epinephrine and steroids intravenously.

There was no personal or family history of respiratory or cutaneous atopy. She was not allergic to any other foods and there was no significant history of drug intake. There was no prior history of seasonal rhinitis/conjunctivitis suggestive of pollen allergy. Latex allergy was ruled out, as she routinely used natural rubber products without any problems. Hemogram and blood biochemistry were within normal limits. A skin prick test (SPT) using the prick-prick technique of Dreborg and Foucard⁶ was carried out with fresh banana and apple pulp. Lychee fruit could not be tested, being out of season. Control pricks with normal saline and histamine were also given and the results were read as per recommendations.⁷ Strongly positive SPTs were recorded with both apple and banana. Serum IgE levels were 210 IU/ml (reference range 0–180 IU/ml). She was advised to carry an emergency kit with epinephrine, antihistamines and corticosteroids at all times and to avoid all fruits and nuts.

Discussion

This patient reported severe type I reactions to three fruits – apple (*Pyrus malus*) banana (*Musa acuminata*) and lychee (*Litchi sinensis*) belonging to three different plant families

– Rosaceae, Musaceae and Sapindaceae, respectively. There was no history of allergic reaction to other Rosaceae fruits such as peach, plum and cherry etc. Positive SPTs to apple and banana, along with strong temporal correlation of symptoms with fruit exposure, confirmed the clinical diagnosis. Some known cross reactors of fruits, inhaled or percutaneous allergens, e.g. latex⁵ and birch pollen,⁶ were ruled out on history.

According to Fernandez-Rivas *et al.*,⁹ allergy to apple and/or other Rosaceae fruits without pollinosis is a distinct and severe clinical entity and more than three-quarters of such patients report anaphylaxis with more than one-third going into shock. These patients also have significantly lower total serum IgE levels than their counterparts with pollinosis. Based on this, we diagnosed our patient to have apple allergy without pollinosis, cross reacting with banana and lychee. As lychee fruit is strictly a nut, and botanically is closely related to other nuts like cashew, pistachio and walnut (family Anacardiaceae),¹⁰ she was advised to avoid all nuts, in addition to fruits.

Whereas apple and other Rosaceae fruits are well-known causes of anaphylaxis,^{3,6,8,9} type I reactions to banana are less common,^{4,5,11} and only one case of anaphylactic reaction to lychee has been reported in the literature.¹² An internet-based search on PubMed and *www.allallergy.net* failed to reveal any report of cross reactivity between these three fruits or other fruits of these families. However, we found one report of a patient allergic to Rosaceae fruits like peach and strawberry as well as banana, guava and mandarin.⁴ This patient reacted to an unidentified 30-kD protein isolated from all these fruits.

Several plant allergens have been identified that are responsible for food-related allergies. Most of these can be classified into one of the 14 groups of pathogenesis-related (PR) proteins that are expressed by all plants in response to stress conditions like infection and wounding etc.¹³ In some plant tissues however, PR proteins are constitutively expressed, e.g. in pollen or fruits, tissues that are more likely to be attacked by pathogens or exposed to adverse environmental conditions.¹³ These PR proteins are plant pan-allergens that are stable at low pH and resistant to proteases, making them efficient food allergens. The ubiquitous nature of PR proteins can explain cases of type I reactions to apparently unrelated plant species like the one reported here.

Profilins (PR-10) are one such family of plant pan-allergens that control actin polymerization in all eukaryotic cells. They participate in the acrosomal reaction in animal sperm cells, and have been postulated to have similar functions in plant pollen.¹⁴ Profilin has been identified as the causative agent in cases of type I allergy to apple,³ in addition to several other food and airborne allergens.¹⁴ The sole reported case of lychee allergy was also found to be sensitive to profilin.¹¹ However, it has been demonstrated that profilin is mostly responsible for pollinosis-associated fruit allergy,^{9,14} and other allergens

are more important in pure fruit allergy. One such class of allergens includes lipid transfer proteins (LTP) (PR-14), which are known to cause nonpollinosis-associated Rosaceae fruit allergy.³ These low-molecular weight (8–10 kD) proteins show a high degree of homology to LTPs from botanically unrelated plants such as sunflower, French bean and maize.¹⁵ Thus LTPs can possibly be causative allergens in cases of multiple fruit allergy. The third recognized allergen in Rosaceae fruits is a thaumatin-like protein (PR-5). These are intensely sweet compounds and possess antifungal activity. Rosaceae fruit-allergic patients reacting to these proteins are known to cross react with bell-pepper (paprika).¹²

Known allergens in banana are β -1-3 glucanases (PR-2), which are responsible for cross reactivity with latex,^{5,13} and class I chitinases (PR-3) with a hevein-like N-terminal domain, which cross react with avocado and chestnut.¹³ Serotonin, which is present in clinically significant amounts in banana, has also been implicated in type I allergy to this fruit.¹⁰

Information on type I allergy to lychee is very sketchy and only a single case report is known, which found evidence of profilin sensitization.¹²

Many new plant allergens such as 2 S albumins,¹⁶ and unnamed proteins of varying molecular masses,^{4,17} have been identified in various fruits, and the importance of these in understanding and diagnosing fruit allergies is increasingly being recognized.

Association between latex allergy and hypersensitivity to fruits is well known and is called the “latex–fruit syndrome”. Apart from banana and apple, a significantly wide variety of fruits and vegetables have been reported to cause severe allergic reactions in latex-allergic patients: avocado, chestnut, tomato, potato, kiwi fruit, melon, sweet pepper, tobacco and azufoifa fruit.^{18,19} As latex-allergic patients are likely to present to dermatologists, it is vitally important to remember the possibility of cross reactions to ingested antigens.

It is obvious from the above discussion that there are several pan-antigens present in plant tissues, especially fruits, seeds and pollen. A high degree of structural homology between these proteins across botanically disparate plant families can explain unusual cases like the one reported here. Atopic individuals and those who have prior history of type I reactions to airborne or contact allergens are at a higher risk for such reactions. However, the predisposing factors to sensitization to these proteins in patients with pure fruit allergies, such as the index patient, are not clear.

Food-induced anaphylaxis is common and its incidence is increasing at a rate above the overall increase in the frequency of anaphylaxis.²⁰ These patients do not usually present to dermatologists, which may result in lack of awareness about this entity. Preventive advice given to these patients should include a list of all possible dietary and other cross-reactors. This is essential to help the patient avoid these allergens as

well as to protect the physician from litigation. In addition, the patient should be advised to always carry an emergency kit containing epinephrine, antihistamines and corticosteroids so that any unexpected cross reactions can be managed promptly.

In reporting this case, our aim was to highlight the relatively rare but potentially life-threatening problem of fruit-induced anaphylaxis, and present an overview of the current understanding of this condition so that accurate diagnosis can be made and proper preventive advice given to these patients.

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