

Conflicting predictions of whole egg versus egg component testing: A case report



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The results of component testing for patients with egg allergy may conflict with the results of whole allergen testing, with the potential of influencing patients' decision to undergo high-risk ingestion challenge. (J Allergy Clin Immunol Global 2025;4:100370.)

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Egg allergy is second in prevalence to milk allergy, with the prevalence estimates varying by mechanism of diagnosis used in the study.¹ For most food allergens, strict avoidance of the food in all forms is recommended. Egg and milk are unique because the major allergens are heat labile and most children are able to tolerate these denatured allergens. In a landmark study, Leonard et al² demonstrated that 89% of children with egg allergy could tolerate baked egg and that regular consumption of baked egg led to a more rapid resolution of egg allergy. Given these findings, ingestion of food containing the denatured form is now in the food allergy practice parameter for children who are able to tolerate the baked food. The only method to definitively determine whether a patient will tolerate baked forms of egg or milk is ingestion challenge. Before ingestion challenge is performed, parents are counseled on the risks of a systemic allergic reaction and the need to administer epinephrine, although a variety of approaches are used to estimate the probability of a systemic reaction. We present a case in which 2 testing strategies diverged in providing risk estimates for a successful ingestion challenge.

RESULTS AND DISCUSSION

A 13-month-old boy with a medical history of eczema presented to the clinic for baked egg challenge. He was previously screened for food allergies because of eczema, with serum IgE level testing showing an egg white-specific IgE level of 96.9 kU/L, ovomucoid IgE level less than 0.10 kU/L, and ovalbumin IgE

higher than 100 kU/L. See [Table I](#). Skin testing was not performed. Because he had no history of systemic allergic reactions with egg, he subsequently tried eating about one-third of a fried egg and immediately developed vomiting at age 8 months. According to a review of the component allergy test results, this sensitization appeared to be directed toward heat-labile ovalbumin and not the heat-stable ovomucoid protein, suggesting that denaturation through heating would lead to tolerance of egg protein in this patient. The component testing results were discussed with the family, and in addition to reading on their own, they thought that their son was likely to tolerate denatured egg proteins. Baked egg challenge was planned. During the challenge, the patient consumed roughly half a muffin containing one-third of an egg before developing fussiness and profuse vomiting. Epinephrine was promptly administered into the anterolateral thigh, with rapid symptom improvement. The patient was deemed intolerant of denatured egg and counseled to strictly avoid all food containing egg protein. The patient's family provided written informed consent for the publication of this case report in the hope of increasing awareness regarding the limitations of egg component testing.

Before the availability of component testing to identify the specific proteins within a food to which a patient was sensitized, IgE to the whole food (containing all proteins) was the standard of treatment. In patients with an egg-specific IgE level exceeding 7 kUA/L, there is a 98% positive predictive value of experiencing an allergic reaction if they ingest an egg.³ Our patient's egg-specific IgE level of 96.9 was considerably higher, and thus the patient was presumed to have egg allergy. However, an ingestion challenge is the criterion standard for diagnosis of food allergy.

The allergenic proteins within egg include ovomucoid, ovalbumin, ovotransferrin, and lysozyme. A patient's IgE binds to specific segments (epitopes) of these different egg proteins. Some of these epitopes are altered by heating or hydrolysis, thereby inhibiting the ability of IgE to recognize the allergen. This is particularly true for epitopes on ovalbumin proteins.⁴ In contrast, ovomucoid epitopes are conformationally stable with heating, increasing the likelihood that foods containing baked egg will still cause a reaction in patients with IgE recognizing ovomucoid proteins. Thus, component testing may increase or decrease the pre-test probability of a patient with egg allergy passing ingestion challenge using baked egg.⁵

Most patients with allergy to eggs are able to tolerate egg protein that has been denatured by baking; regular consumption of these denatured egg proteins leads to resolution of the egg allergy in more than half of patients.² Even for those who are unable to overcome the egg allergy entirely, quality of life is enhanced when food containing baked egg can be consumed.⁶ For these reasons, an increasing number of families seek baked

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The patient's family has provided consent to publish this case report

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TABLE I. Patient's values for whole egg and components before ingestion challenge

Component testing	Allergen-specific IgE titer, kU/L	Class
Egg white	96.60	5
Egg yolk	21.70	4
Allergen, ovomucoid IgE	<0.10	0
Allergen, ovalbumin IgE	>100.00	6

egg ingestion challenge to determine whether their child is tolerant.

Not all studies support component testing as superior to whole egg in predicting outcomes in baked egg challenge. In predicting which patients will have favorable outcomes, 32% of patients with a total egg-specific IgE level greater than 10 kAU/mL experienced resolution of their egg allergy following completion of baked egg challenge, compared with 62% of patients who had a baseline IgE level less than 2 kUA/mL.⁷ Although component testing appeared to provide reassurance that our patient would pass baked egg challenge, his total egg-specific IgE level suggested that tolerance was unlikely and that his egg allergy would persist. Despite the patient's negative blood result to ovomucoid IgE (ie, <0.10), an anaphylactic reaction following oral baked egg challenge that required epinephrine for resolution was still experienced. In oral challenges to baked egg preparations, anaphylactic reaction precautions should still be taken despite a negative result of component testing to ovomucoid IgE. In addition to failing owing to preservation of an epitope after denaturing of the protein, there is variability in the extent of denaturing, even when a standardized recipe is used, which may explain reactions in some patients.⁸ Additionally, the use of wheat appears to play an important role in determining the likelihood of passing an ingestion challenge. As with our patient, a very high specific IgE level decreases the likelihood that egg allergy will resolve.⁹ This may be due to an increase in the likelihood that nondenaturable epitopes are targeted by IgE. Measurement of the level of IgE capable of binding to specific epitopes of ovomucoid (eg, sequential epitopes that are less susceptible to denaturing) may be helpful in identifying patients who are intolerant of baked egg, but these tests are not currently widely available.

Although there remains variability in practice with regard to using total egg versus egg component testing to determine risks of a reaction with ingestion challenge, it is important to recognize that IgE testing, including component testing, affects the probabilities of reaction and is not used to definitely diagnose allergy or to determine the severity of an allergic reaction. It is important to interpret results of allergy testing to families and explain the resulting probabilities rather than providing a dichotomous yes or no result, as well as to explain that immune responses to food include tolerogenic factors that change over

time. For these reasons, indiscriminate food allergy panels should never be ordered owing to the very high rates of false-positive results that are found. False-negative results are also possible with these tests.³ Given these nuances, physicians who are not prepared to discuss probabilities of clinical outcomes should refer patients to an allergist to perform the testing and engage in a joint decision-making process, aligning a family's risk tolerance with the probability of a failed ingestion challenge. In addition to serum testing, allergists may incorporate skin testing and basophil activation tests to use in their joint decision-making process when ingestion challenges are considered.

Early introduction of allergenic foods is now recommended, particularly for children at higher risk for development of food allergies. This includes infants with eczema who are at risk for development of food allergy, allergic rhinitis, and asthma as components of the "atopic march." Early introduction of allergenic foods can be difficult, as not all infants will consume the allergenic foods in quantities sufficient to prevent food allergies. For children with a history of atopy, early introduction of allergens is now the standard intervention for allergy prevention, with the current guidelines recommending a progressive introduction of solid foods, including allergenic solids, in the first year of life. While we await safer and more effective methods of curing food allergy, prevention remains the most important strategy.

DISCLOSURE STATEMENT

Disclosure of potential conflict of interest: The authors declare that they have no relevant conflicts of interest.

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