Identification of Duck Egg Vitellogenin as the Cause of Selective Anaphylaxis to Duck Egg

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Allergy to duck egg is rare and usually associated with IgE-mediated hypersensitivity to other types of bird egg, mainly hen egg [1,2]. While infrequent, cases of selective duck egg allergy have been reported [3-5]. We present the case of an adult patient who experienced anaphylaxis after ingestion of duck egg (with vitellogenin as the culprit allergen) and who subsequently tolerated hen egg.

A 71-year-old man with no personal history of interest developed oropharyngeal and palmoplantar pruritus immediately after eating flan made with duck and hen eggs. Thirty minutes later, he developed abdominal pain with vomiting and generalized urticaria. The patient self-medicated with antihistamines, and his symptoms gradually resolved. However, he did not request emergency medical attention. The patient lives in a rural area and keeps chickens and ducks. One week later, he ate cooked duck egg and developed hives, abdominal pain, and vomiting 5 minutes after ingestion. On this occasion he requested medical attention, receiving emergency treatment with dexchlorpheniramine 5 mg, methylprednisolone 40 mg, adrenalin, and fluid therapy. His symptoms resolved. Since both episodes, the patient has tolerated hen egg and chicken meat and continues to avoid duck egg.

Skin prick tests were performed with commercial extracts (Roxall) of chicken egg and fractions, the most frequent aeroallergens in our area, a food extract series (cow milk, hen egg, shrimp, *Anisakis simplex*, gluten, cod, veal, peanut, soybean, wheat), and panallergens (nsLTP [Pru p 3], pollen profilin), all of which yielded negative results. Prick-by-prick test with raw duck egg, white, and yolk yielded positive results: 10 mm (yolk) and 5 mm (white). Histamine was used as a positive control (4 mm) and saline as a negative control. Basal tryptase (3.2 µg/mL) and total immunoglobulin IgE (363 IU/mL) were determined, as

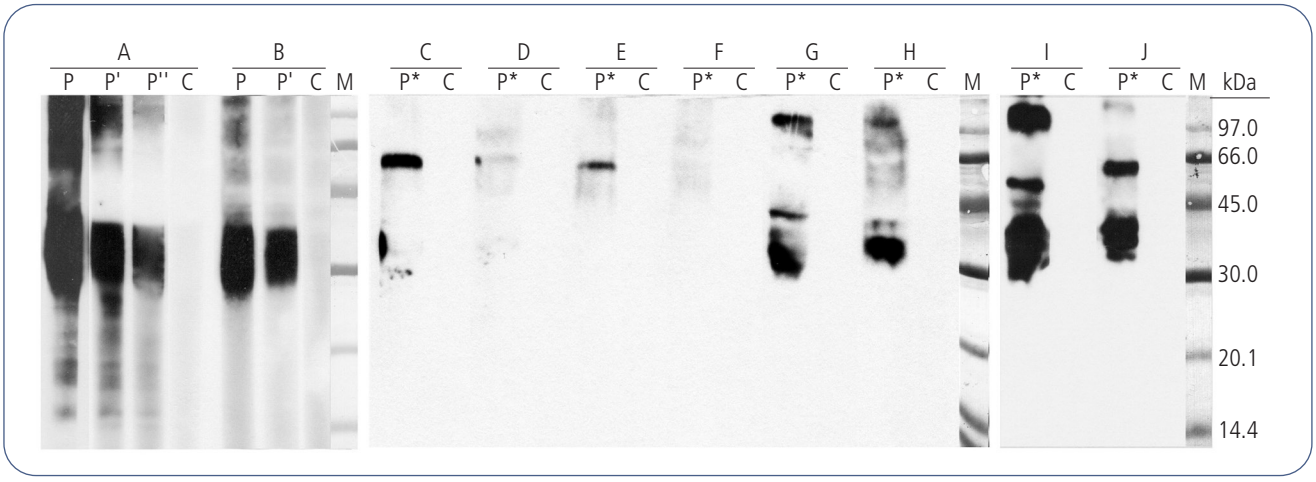

Figure. SDS-PAGE immunoblotting under reducing electrophoresis conditions (2-mercaptoethanol) with extracts of egg yolk and egg white from duck, chicken, quail, guinea fowl, and ostrich eggs. A, Duck egg white. B, Duck egg yolk. C, Hen egg white. D, Hen egg yolk. E, Quail egg white. F, Quail egg yolk. G, Guinea fowl egg white. H, Guinea fowl egg yolk. I, Ostrich egg white. J, Ostrich egg yolk. Lane P, P′, P″, P*: patient serum at dilutions of 1/100, 1/200, 1/500, and 1/4, respectively, Lane C: Control serum (pool of sera from nonatopic individuals), Lane M: Molecular mass standard.

were specific IgE (ImmunoCAP, Thermo Fisher Scientific) to hen egg (0.46 kU_A/L), hen egg white (0.75 kU_A/L), hen egg yolk (0.2 kU_A/L), ovomucoid (0.35 kU_A/L), ovalbumin (0.07 kU_A/L), conalbumin (0.05 kU_A/L), and lysozyme (0.1 kU_A/L). The patient reported tolerance to hen egg obtained in different types of food (omelet, homemade ice cream, and boiled egg). Since the patient experienced 2 episodes of anaphylaxis after ingestion of duck egg, an oral challenge test with duck egg was not performed for ethical reasons and to avoid unnecessary risk. Similarly, he refused to undergo testing of tolerance to other poultry eggs.

Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) immunoblotting was performed with the patient's serum under reducing electrophoresis conditions (2-mercaptoethanol) and extracts of egg yolk and egg white from duck, chicken, quail, guinea fowl, and ostrich eggs. A main IgE binding band of approximately 33 kDa was detected in duck egg white and yolk with various highly diluted serum samples (1/100, 1/200, 1/500). A band with the same molecular mass was detected in egg white and yolk from guinea fowl and ostrich at a much lower serum dilution (1/4) (Figure). A 66-kDa band was detected in duck egg white with serum 1/100 and with a much lower dilution (1/4) in hen egg white, quail egg white, and ostrich egg yolk. The high intensity of IgE binding detected in the 33-kDa band in duck egg and the absence of this band in samples of the tolerated hen egg led us to suppose that the 33-kDa IgE-binding band could be responsible for duck egg anaphylaxis.

The 33-kDa protein was identified using mass spectrometry, as previously reported [6], by searching a nonredundant protein sequence database (NCBI) using the Mascot program (http://www.matrixscience.com) in the Proteomic Service of Complutense University of Madrid, which is a member of the ProteoRed Network. Research conducted with protein databases identified the 33-kDa protein as duck vitellogenin. Written informed consent was obtained from the patient for all in vitro and in vivo studies.

Although rare, duck egg allergy is often associated with sensitization to and symptoms induced by eggs of other birds [1]. However, cases of duck egg allergy with tolerance to chicken egg have been reported [3-5]. These studies implicated ovalbumin [3,4] and lysozyme [5] as allergens potentially involved in selective reactions to duck egg, although proteins were not always identified and, in contrast with the present case, vitellogenin was not involved. The reverse situation has also been described in children with hen egg allergy and tolerance to duck egg [7]. In our study, we identified the 33-kDa protein from duck egg, which had high IgE-binding capacity and proved to be duck vitellogenin. Vitellogenin is a precursor of the lipoproteins and phosphoproteins in egg yolk. Its function is to transport lipids and proteins from the liver thorough the oocytes before becoming part of the yolk. It can be found in all oviparous species including birds and fish. Vitellogenin from chicken eggs (Gal d 6, present in egg yolk) [8] and from some fish eggs [9,10] has been reported to be an allergen from these allergenic sources. Our testing of the patient's serum revealed very high levels of specific IgE against the 33-kDa protein. Therefore, we assume that even if there is a small amount of the protein in the egg white, it would be clearly detectable. We identified vitellogenin (Gal d 6), which was previously described as the second allergen in chicken egg [8], as the allergen responsible for the selective anaphylactic reaction to duck egg in the present case. Gal d 6 is yolk glycoprotein 42, a fragment of vitellogenin 1. It is a heat-resistant protein, although it can be digested by pepsin allergen. Together with vitellogenin 2, it is one of the main components of yolk. Its cleavage produces apolipovitellins and phosphovitellins, which are components of the granular yolk lipoproteins [8].

In summary, we present a rare case of duck egg allergy in an adult patient with no history of atopy and with subsequent tolerance to chicken eggs. The vitellogenin appeared to be the allergen involved in the anaphylactic reaction. Our findings suggest that duck egg allergy can be independent of hen egg allergy.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

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