

Egg baked in product open oral food challenges are safe in selected egg-allergic patients

Becky J. Buelow, M.D., M.S.,¹ Carrie Lee, A.P.N.P.,¹ Heidi T. Zafra, M.D.,¹ Mahua Dasgupta, M.S.,² Ray G. Hoffmann, Ph.D.,² and Monica Vasudev, M.D.³

ABSTRACT

Egg allergy is one of the most common food allergies in children. Most egg-allergic children are able to tolerate egg baked in product (EBP) and will likely outgrow his/her egg allergy. By introducing EBP in the diet of an egg-allergic child, diet can be expanded and family stress can be reduced. Recent evidence suggests that children who tolerate EBP and continue to consume it will have quicker resolution of egg allergy than those who strictly avoid EBP; therefore, we aimed to evaluate the egg-allergic children who underwent EBP oral food challenge (OFC) in our allergy clinic to help define any specific predictors to be used in predicting the outcome of such challenges. We performed a retrospective chart review and 43 egg-allergic patients underwent EBP OFC in our outpatient allergy office from January 2011 to December 2012 were excluded. Nine patients who did not have a prior history of symptomatic egg ingestion. Clinical characteristics and laboratory findings of the remaining 34 patients were all recorded and analyzed. Of the remaining 34 patients, 22 (64.7%) were boys. Average age of first reaction to egg was 12.90 months, with average age at EBP OFC of 71.32 months. The average of the most recent skin-prick test wheal size was 10.10 mm and serum-specific IgE to egg white was 3.21 kU/L. Twenty-eight of the 34 patients (82.4%) passed the EBP OFC. Of the six patients who failed, none required epinephrine. After analysis of all of the clinical characteristics and laboratory findings, no risk factors, such as skin-prick test wheal size, were identified to be associated with an increased risk of failing EBP OFC. EBP OFC is a valuable tool to assess tolerance. As seen in our group of patients, the majority of egg-allergic patients pass EBP OFC. Thus, OFC should be considered as a clinical tool to expand a patient's diet and to improve quality of life as early as possible. Because we were unable to determine any clinical or laboratory predictors helpful to select egg-allergic patients who are likely to pass EBP OFC, additional prospective studies are necessary to determine the ideal egg-allergic patient who is likely to pass EBP OFC.

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Egg allergy is one of the most common food allergies in the pediatric population.¹ Recent literature has estimated 68% of egg-allergic children will tolerate plain egg by age 16 years, suggesting that the majority of children outgrow their egg allergy later than previously described.² Because egg is a common ingredient and avoidance can be burdensome, quality of life is negatively affected.³

Approximately 80% of egg-allergic patients tolerate egg baked in product (EBP).⁴ Leonard *et al.*, and more recently, Peters *et al.*, suggest egg-allergic patients who tolerate EBP with continued ingestion may tolerate plain egg sooner than those who strictly avoid all forms of egg.^{5,6} This phenomenon may represent the natural history of egg allergy accord-

ing to Peters *et al.*⁶ Thus, introduction of EBP to egg-allergic patients using oral food challenge (OFC) can expand diet and possibly accelerate tolerance to plain egg. We sought to retrospectively review the number of egg-allergic patients who passed EBP open OFC in our academic multipractitioner allergy clinic to help determine if any risk factors would predispose patients to OFC failure and if we can safely consider recommending OFC at home in appropriately chosen patients.

Children's Hospital of Wisconsin (CHW) Institutional Review Board approval was obtained. We reviewed charts of patients who underwent EBP OFC from January 2011 to July 2013. Each patient was diagnosed with clinical egg allergy based on clinical history and a positive skin-prick test to egg and/or serum-specific IgE to egg white during a clinic visit with an allergist at CHW. Patients were chosen for EBP OFC based on clinical judgment and family interest. No skin-prick testing size or level of serum-specific IgE to egg white was used as a cutoff for OFC. Nine patients who were sensitized to egg without symptomatic ingestion were excluded from further analyses. Table 1 summarizes clinical and laboratory characteristics of the remaining 34 patients challenged. Mann-Whitney

From the Divisions of ¹Allergy, Asthma, and Clinical Immunology at Children's Hospital of Wisconsin, and ²Quantitative Health Sciences, Department of Pediatrics, Medical College of Wisconsin, Milwaukee, Wisconsin, and ³Aurora Medical Group, Aurora Sheboygan Medical Center, Sheboygan, Wisconsin

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Address correspondence to Becky J. Buelow, M.D., M.S., Medical College of Wisconsin, 9000 West Wisconsin Avenue, CCC Suite 440, Milwaukee, WI 53226
E-mail address: bbuelow@mcw.edu

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Table 1 Characteristics of patients who underwent and either passed or failed EBP open OFC in our outpatient clinic

Patient Demographics	Total (n = 34)	Passed OFC (n = 28)	Failed OFC (n = 6)	p Value
Gender (male)	22 (64.7%)	20 (71.4%)	2 (66.7%)	0.15#
History of allergic rhinitis	23 (67.6%)	19 (67.9%)	4 (66.7%)	>0.90#
History of atopic dermatitis	16 (47.1%)	14 (50.0%)	2 (33.3%)	0.66#
History of asthma	16 (47.1%)	13 (46.4%)	3 (50.0%)	>0.90#
History of multiple food allergies (≥2 food allergies)	20 (58.8%)	16 (57.1%)	4 (66.7%)	>0.90#
History of anaphylaxis to egg (initial documented reaction)	7 (20.6%)	4 (14.3%)	3 (50.0%)	0.09#
Mean age at EBP OFC (patient age ranges in months)	71.32 mo (14–165 mo)	74.25 mo (25–165 mo)	57.67 mo (14–147 mo)	0.30§
Average age at first reaction to egg* (patient age ranges in months)	12.90 mo (6–24 mo)	12.71 mo (6–24 mo)	13.75 mo (9–24 mo)	0.78§
Time between first reaction to egg and EBP OFC* (patient age ranges in months)	56.32 mo (8–159 mo)	56.58 mo (8–159 mo)	63.75 mo (26.4–135 mo)	0.75§
Most recent SPT before EBP OFC (wheal in mm)**	10.10 (0–30)	9.81 (0–20)	11.6 (0–30)	0.94§
Most recent serum-specific IgE to egg white before EBP OFC (ImmunoCAP, kU/L)***	3.21 (<0.35–23.2)	3.44 (<0.35–23.2)	1.76 (<0.35–4.06)	0.62§

*21, **31 and ***30 patients had available data for these patient demographics.

#Fisher's exact test.

§Mann–Whitney Wilcoxon test.

OFC = oral food challenge; EBP = egg baked in product.

nonparametric tests were used to compare groups with ordinal or continuous outcomes. Two-sided Fisher's exact tests were used to compare binary outcomes.

Thirty-one of 34 patients challenged used our standard EBP protocol consisting of a boxed cake mix with three eggs baked at 350°F for at least 30 minutes. The remaining three patients ingested baked cookies, donuts, or bread during OFC. Each patient was given variable amounts of EBP with no minimum amount of ingestion. Twenty-eight of 34 patients (82.4%) passed the EBP OFC. A positive or failed OFC was defined as when the patient refused to eat the EBP and/or had clinical symptoms with EBP ingestion requiring treatment. In one case, the caregiver was uncomfortable with continuation of the OFC after localized rash was observed and treated. Six patients failed: two did not complete the OFC secondary to being uncooperative with ingestion of EBP and four developed mild symptoms representing an IgE-mediated reaction needing treatment. The reactions of these four patients included one with localized rash only, two with gastrointestinal upset (one with nausea and abdominal discomfort and the other with nausea and subsequent emesis), and one with localized rash above the upper lip and wheeze

cleared with cough. One of the four patients who failed EBP OFC did not ingest the standard baked boxed cake mix; the patient ingested baked cookies and had nausea and emesis during OFC. All four patients who had symptoms received an antihistamine and one received albuterol. No patients received epinephrine. On statistical analysis, no predictors were identified to be associated with an increased risk for failing EBP OFC (Table 1). However, a history of anaphylaxis on initial reaction did approach significance and may be a significant risk factor for failure if our sample size were larger.

EBP OFC is a valuable tool to assess tolerance and possibly to expand diet. Our study showed tolerance in >80% of patients, confirming previous studies.^{4–6} Given this high pass rate, EBP OFC should be considered for egg-allergic patients. Unfortunately, recent work, including our study, has not defined a significant specific factor to predict which egg-allergic patients will likely pass EBP OFC (Table 1). Skin-prick test wheal size and serum-specific IgE are of particular interest to allergists but in our study skin-prick test wheal size did not differentiate between passing or failing the EBP OFC. There is a suggestion that IgE

could improve the sensitivity, but the small number of failures did not allow that to reach statistical significance. Because outpatient OFC may have limited availability, larger studies are necessary to help determine any predictors of failing EBP OFC. If identified, these predictors would be valuable in selecting patients who are more likely to pass EBP OFC.

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