



## Beef Allergy after Bovine Cardiac Conduit Placement: A Case of Potential Implant-Related Sensitization

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### Abstract

IgE-mediated beef allergy is uncommon in children. We share how an eight-year-old boy with congenital heart disease developed immediate, reproducible reactions to home-cooked beef despite prior tolerance. Surgical history was significant for bovine-derived cardiac conduit during infancy, with partial graft material remaining after synthetic replacement. Allergy workup demonstrated elevated beef-specific IgE with negative alpha-gal serology. The patient tolerated other mammalian meats and dairy, suggesting selective sensitization to beef. He had no tick exposures or travel outside of the state. This novel case highlights a potential association between bovine-derived conduit exposure and subsequent IgE-mediated beef allergy. More investigation is warranted to clarify the risk of IgE-mediated allergy in patients with biologic grafts.

**Keywords:** IgE-mediated beef allergy; Biologic graft; Bovine vein conduit; Mammalian meat allergy; Alpha-gal syndrome

### Introduction

IgE-mediated beef allergy is scarcely reported in the pediatric literature and remains poorly characterized. We report an eight-year-old boy with complex cardiac history who had a bovine-derived cardiac conduit and experienced recurrent reactions concerning for IgE-mediated beef allergy, raising suspicion for graft-related sensitization.

### Case Presentation

The patient first presented to the allergy clinic at eight years old with concern for beef allergy. Concerns for beef allergy started when the patient was six years old. He began to experience immediate symptoms of cough, lip angioedema, and emesis within bites of home-cooked beef. In total, there were six separate episodes of the same type of reaction. Symptoms resolved with oral antihistamines. He did not require emergency care or epinephrine administration. Previously, he tolerated beef without reactions, and he continued to eat other red meats (pork, yak), poultry (turkey, chicken), and gelatin products (fruit gummies). He tolerated common food allergens (peanuts, almonds, egg, dairy, wheat, fish and soy). The patient had uncomplicated asthma that was well-controlled on daily low-dose inhaled corticosteroids. Family history was notable for asthma in his mother and atopic dermatitis in a sibling; there was no history of food allergy. He had two dogs at home, lived exclusively in Colorado, and had no tick exposures.

His surgical history was significant for multiple cardiac repairs since birth for Shone complex, a rare congenital heart disease involving left-sided obstructive lesions, including coarctation of the aorta. At 10 months old, a conduit from the right ventricle to the pulmonary artery derived from a bovine jugular vein was placed via the Ross-Konno procedure. At seven years old, he underwent valve-sparing aortic root replacement with hemiarach reconstruction, as well as graft replacement of the original bovine conduit with a synthetic graft. However, there was a small portion of the previous bovine graft that was left in place.

Physical examination at allergy evaluation was unremarkable. Serum testing demonstrated elevated total IgE at 62.5 kUA/L (reference 0.0-52.0) and beef-specific IgE of 2.60 kUA/L (0.00-0.34). Galactose- $\alpha$ -1,3-galactose ( $\alpha$ -gal) specific IgE was 0.30 kUA/L (<0.70), corresponding to Class 0/1 (borderline/equivocal, 0.10-0.34). Serum  $\alpha$ -gal specific IgE was 0.48% of total IgE. Baseline serum tryptase was normal at 2.7 ng/mL (<11.5); plans were made to repeat tryptase levels if future episodes suggested anaphylaxis. Given concerns for IgE-mediated beef allergy, strict beef avoidance was recommended. He was instructed to carry oral antihistamines for mild symptoms and an

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Received Date: 06 Mar 2026

Accepted Date: 23 Mar 2026

Published Date: 24 Mar 2026

#### Citation:

Crain NA, Hicks AG. Beef Allergy after Bovine Cardiac Conduit Placement: A Case of Potential Implant-Related Sensitization. *Ann Clin Case Rep.* 2026; 11: 2828.

ISSN: 2474-1655.

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epinephrine autoinjector for potential anaphylaxis. The possibility of a supervised oral food challenge to beef was discussed, and repeat beef specific IgE testing and one-year follow-up were arranged.

## Discussion and Conclusion

IgE-mediated beef allergy is uncommon, and true allergic reactions to beef are difficult to ascertain. Early studies report that in pediatric populations with positive Skin Prick Testing (SPT), beef sensitization and clinical reactivity may be as high as 6.5%, suggesting beef allergy may be more common than previously considered, especially in children with atopic dermatitis [1]. Because atopic dermatitis affects nearly 5% of the general pediatric population, overall prevalence of beef allergy may be 0.3%, underscoring its potential relevance in the pediatric allergy practice [2]. More recently, Topçu, et al. evaluated 6000 schoolchildren and found that while 2.6% of parents suspected IgE-mediated beef allergy, only 0.3% of cases were verified by beef challenges [3]. Confirmed reactions were significantly more likely in children with a family history of beef allergy and positive testing. In particular, a beef specific IgE threshold >5 kUA/L, or the combination of family history plus SPT or beef specific IgE >3 kUA/L, strongly predicted positive challenges [3]. Our patient's six immediate, reproducible reactions without an alternative trigger and positive beef specific IgE was suspicious for IgE-mediated allergy. Interestingly, he lacked atopic dermatitis and family history of beef allergy, and, while positive, had beef specific IgE <5 kUA/L. According to observations by topco and colleagues, a future food challenge may be a reasonable option for our patient to confirm IgE-mediated beef allergy.

Immunologic mechanisms underlying IgE-mediated beef allergy remain incompletely understood. Bovine serum albumin is believed to be the primary allergenic protein in beef-allergic children and may overlap mechanistically with cow's milk allergy [4]. Food processing may also influence clinical reactivity. Industrial heat treatment appears more effective than home cooking in reducing allergenicity, likely due to a more uniform protein denaturation in the meat-protein matrix [5]. On extensive diet history, our patient only reacted to beef prepared at home. Given his tolerance to dairy and other mammalian meats, it raises the question whether beef that has undergone controlled thermal processing, like in industrial preparation, may alter his clinical reactivity.

Adverse reactions to beef appropriately raise suspicion for alpha-gal syndrome. Alpha-gal syndrome typically presents in adulthood and is characterized by delayed (2-6 hour) reactions, ranging from hives to severe anaphylaxis, to mammalian meat after prior tolerance. Diagnosis is supported by positive  $\alpha$ -gal specific IgE, often  $\geq 1\%$  to 2% of total IgE, and improvement with red-meat avoidance; nevertheless, unclear histories or negative testing can complicate evaluations [6].

Alpha-gal reactions are documented in the literature as the primary mechanistic explanation for reactions to beef or pork products. In cardiac implant populations, transplantation of bovine or porcine heart valves has been associated with urticaria and wheezing in patients sensitized to  $\alpha$ -gal [7]. Additional studies suggest mammalian valves can increase the immune response to  $\alpha$ -gal, [8] and biologic products may degenerate more rapidly in individuals with  $\alpha$ -gal specific IgE [9]. In our patient, alpha-gal syndrome was unlikely given immediate rather than delayed reactions, absence of tick exposure or travel outside Colorado, lack of intolerance to other red meats, and a low  $\alpha$ -gal IgE to total IgE ratio. Nevertheless, alpha-gal syndrome could be reconsidered if symptomology, future exposures, travel history, or laboratory parameters change.

This report brings attention to the potential association between bovine graft exposure and IgE-mediated beef allergy. Longitudinal studies and surveillance of adverse beef reactions would help clarify the true incidence of IgE-mediated beef allergy compared to alpha-gal syndrome, especially in populations with bovine-derived implants.

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