

Transfer of Peanut Allergy From the Donor to a Lung Transplant Recipient

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Among solid organs, transfer of peanut allergy from donor to recipient has been implicated after liver transplantation. We report the first case in which such transfer occurred after a lung transplant. A 42-year-old woman with history of sarcoidosis underwent a successful bilateral lung transplant from a donor who died from anaphylactic shock after eating peanut-related food. Seven months later, she ate a peanut butter cookie at a transplant support group meeting. Immediately thereafter, she developed an anaphylactic reaction, but survived with prompt treatment. During subsequent follow-up, she could recall three prior episodes of wheezing and difficulty breathing after eating peanut-related foods. The first episode occurred 4 days after the transplant. Prior to her transplant, she never had problems eating peanuts. Skin-prick testing confirmed peanut sensitization. She avoided peanuts and, although her skin-prick test became negative, she still manifested peanut allergy when formally challenged orally with the food. She was advised to continue abstaining from all peanut-related foods. This case emphasizes the importance of considering donor allergy transfer when caring for all solid-organ transplant recipients in order to avoid a life-threatening event. *J Heart Lung Transplant.*

Peanuts are one of the leading causes of food-related allergic reactions in the USA.^{1,2} Food allergy affects about 6% to 8% of children <4 years old and about 2% of the U.S. population beyond the first decade of life.³ It accounts for about 30,000 anaphylactic reactions, 2,000 hospitalizations and 200 deaths each year in the USA.⁴ Allergy to peanuts or tree nuts is responsible for the majority of these fatal and near-fatal anaphylactic reactions, which usually happen after accidental exposure to the food.⁵⁻⁸ Similar trends have been reported in Europe.⁹ Food-induced anaphylaxis is primarily a clinical diagnosis and is often mistaken for status asthmaticus or an acute cardiovascular event.¹⁰ The evaluation should include careful history-taking, skin-prick testing, radioallergosorbent tests and, possibly, an oral food challenge.¹⁰

Allergy to peanuts is a mast cell-dependent immediate-hypersensitivity reaction mediated by IgE.¹¹ Transfer of this hypersensitivity after bone marrow transplantation is well recognized.¹²⁻¹⁵ Allergy acquired through this transfer is thought to result from adoptive transfer of IgE-producing donor-derived B cells.¹⁵ In contrast,

transfer of peanut allergy through solid-organ transplant is thought to be rare. We were able to identify only 2 such cases published in the literature. One occurred after a combined liver-kidney transplant and the other after a liver transplant.^{11,16} In both reports, the liver was implicated as the likely organ responsible for transfer of such sensitivity based on the fact that other organ transplants from the same donors did not transfer allergic sensitivity to peanuts.^{11,16} We report the first case of transfer of peanut allergy from donor to recipient after lung transplantation.

CASE REPORT

The donor lungs were from a 12-year-old with history of asthma who died from anaphylactic shock after eating peanut-related food. The bilateral lung recipient was a 42-year-old woman with sarcoidosis and pulmonary hypertension. On her fourth post-operative day, she ingested a peanut-containing chocolate bar. Soon after, she became short of breath. She was treated with nebulized bronchodilators and her symptoms improved. She did not correlate the episode with eating the bar nor did she mention this to her physicians. Prior to transplant, peanut-containing foods had been a part of her diet without any problem. She was subsequently discharged from the hospital with an immunosuppressive regimen that was started immediately post-surgery and included corticosteroids, azathioprine and cyclosporine.

Approximately 5 weeks post-transplant, the patient was driving to the pulmonary rehabilitation center

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when she ate a peanut butter sandwich. By the time she reached the center, she had become extremely short of breath. She was also found to be hypoxic with oxygen saturation of 88% and was admitted to the hospital. Extensive work-up, including bronchoalveolar lavage and transbronchial biopsies, did not show any evidence of infection or acute rejection. The patient's condition improved with supportive therapy. A third episode of wheezing and mild shortness of breath occurred 4 months post-transplant, when she ingested a piece of peanut butter cracker at home and was relieved by albuterol. Again, she did not associate these events with eating peanut-related food and failed to mention it to her physicians.

At 7 months post-transplant, the patient came to the hospital to attend a transplant support group meeting, and ate a peanut butter cookie. She immediately had severe shortness of breath with significant wheezing followed by lip swelling, urticaria and dizziness. She was promptly transferred to the emergency department. She was in severe respiratory distress, had significant bilateral wheezing and was profoundly flushed. Her oxygen saturation was 78% on room air and heart rate was 122 beats/min. She was treated with epinephrine, oxygen, albuterol nebulization, intravenous methylprednisolone, ranitidine and diphenhydramine. Her chest radiograph was normal. Her condition improved after the treatment and she was discharged after overnight observation in the hospital.

In retrospect, the patient could now clearly relate the prior three episodes of wheezing and difficulty breathing with the ingestion of peanut-related foods. These were the only times she ate food with peanut derivative and did not have any episode of dyspnea otherwise. She did have two episodes of asymptomatic mild rejection at 1 month and 6 months post-transplant, diagnosed on routine surveillance biopsies and treated successfully with high-dose steroids.

The patient was referred to the Allergy Clinic for testing of possible food allergens. She underwent skin testing with various nuts and foods and was found to have a positive skin-prick test to peanuts only. She was advised to strictly avoid peanut products, for which she complied, except for a few instances where she inadvertently ingested minute quantities of peanut-derivative foods and used albuterol inhalation for successful symptom relief.

Upon re-evaluation 5 years post-transplant, the patient was found to have a negative skin test to peanut, as well as undetectable peanut-specific IgE levels by in vitro enzyme-linked immunoassay (ELISA) testing (<0.35 kU/liter; Pharmacia-ImmunoCAP method). She was offered a confirmatory oral peanut challenge test, but she declined at the time (Table 1).

Table 1. Skin-prick Testing Results^a

Allergen	7 months post-transplant (scale from 0 to 4 ⁺)	5 months post-transplant (wheal/flare mm)
Saline control	0	No wheal/flare
Histamine control	3 ⁺	10/25
Peanut extract	3 ⁺	No wheal/flare

^aWheal and flare measurements were not recorded on initial testing at 7 months post-transplant. The following standard scoring system was used at our institution at the time of testing: 0—no skin reaction or reaction no different than negative control; 1⁺—erythema <21 mm; 2⁺—wheal diameter <3 mm and erythema >21 mm; 3⁺—wheal diameter >3 mm with surrounding erythema; 4⁺—wheal diameter with pseudopods and surrounding erythema.

Subsequently, repeat peanut skin-prick testing was performed 7 years post-transplant, which was again negative. With the patient's consent, an open oral peanut challenge was then performed. Baseline pulmonary function on the day of challenge revealed a forced expiratory volume in 1 second (FEV₁) of 1.09 liters (47% predicted) and a FEV₁/forced vital capacity (FVC) of 53 liters, similar to her recent spirometric values. Mucosal and graded oral challenge was tolerated until 30 minutes after the ingestion of one peanut, when she reported chest tightness. Her FEV₁ at that time had dropped to 0.87 liters (20% decline). Further challenge was terminated taking into account patient's already borderline pulmonary status. FEV₁ normalized to 1.16 liters and symptoms resolved after albuterol administration.

The other recipients from the donor were then checked. One person received a kidney-pancreas and another had a kidney transplant from the same donor, but neither reported any problems with peanuts.

DISCUSSION

We report a case of transfer of symptomatic peanut allergy from the donor to a lung transplant recipient. This suggests that transfer of food allergy can occur in solid-organ transplants other than the liver. The initial allergic reactions in our patient were less severe, and may be partly explained by the high dose of corticosteroids the recipient was on early after the transplantation. Although our donor died from an anaphylactic reaction, the lungs were still transplanted and the recipient is still doing well 7 years post-transplant. This supports the notion that anaphylactic shock in itself should not be a contraindication for transplantation as long as the donor's PaO₂/Fio₂ before harvest is >350 and other eligibility criteria are met.¹⁷

It is very difficult to ascertain the exact mechanism by which allergy was transferred in our patient. As the initial reaction occurred in the patient 4 days after the

transplant, it is possible that passive transfer of anti-peanut IgE may have occurred from the donor to the recipient via donor mast cells.¹⁸ Human lung tissue contains approximately 600,000 mast cells per gram with each mast cell possessing approximately 135,000 IgE receptors.¹⁹ Serum IgE has a half-life of only 2 to 4 days, but once IgE binds to mast cells the biologic half-life is prolonged.^{20,21} This conforms to the observation that passive transfer of IgE in the Prausnitz-Küstner and Walzer reactions can persist for up to 6 months.^{16,20}

Although mast cells bind IgE with high affinity, the large burden of transplanted mast cells could degranulate with release of mediators in the recipient after peanut exposure, causing the observed symptoms. In addition, the presence of a positive skin test after the anaphylactic episode suggests that sufficient peanut-specific IgE was released from the transplanted mast cells with subsequent binding to mast cells in the skin. This, however, does not explain the positive food challenge 7 years post-transplant in the absence of a positive skin-prick test and undetectable peanut-specific IgE, unless local pulmonary persistence of IgE is hypothesized.

Another likely mechanism that could explain the persistence of allergy is what was described in the case of a liver transplant patient.¹¹ Peanut-specific IgE-producing B cells or peanut-specific Th2 lymphocytes transferred from the donor at time of surgery can induce peanut-specific IgE in the recipient and may explain the persistence of allergy even well after the transplant (Figure 1).

Just like the fundamental questions of why food allergy develops in one person and not another and why only some foods are frequently implicated in this process is unknown, the exact mechanism responsible for the transfer of allergy remains to be elucidated.^{16,22} In the interim, it is imperative that physicians take extra

caution when solid-organ donors are known to have severe food allergy. Allergen skin testing and cautious food challenge may be a prudent and conservative approach in selective recipients from such donors. This simple step could help avoid a life-threatening incident in this already high-risk patient population.

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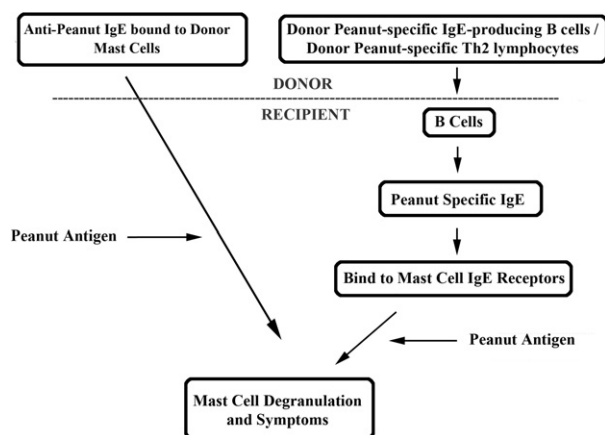


Figure 1. Possible mechanisms of transfer of peanut allergy from the donor to a transplant recipient.