

Latex Allergy in Children on Home Mechanical Ventilation*

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Study objective: Determining the incidence of latex allergy in children receiving home mechanical ventilation.

Background: The prevalence of latex allergy in the general population ranges from 0.1 to 1.0%. However, in patients with spina bifida and other chronic medical conditions associated with repeated exposure to latex, the prevalence may be as high as 60%. Children receiving home mechanical ventilation are frequently exposed to latex products. Therefore, we hypothesized that these children would be at increased risk for latex allergy.

Design: Fifty-seven children receiving home mechanical ventilation (31 boys, 26 girls; mean [$\pm$ SD] age, 7.8 ± 6.6 years; range, 0.3 to 23.2 years) were enrolled. A radioallergosorbent test (RAST) for latex was administered and serum IgE levels were obtained in all patients.

Results: Seventeen patients (29.8%) were found to have a positive RAST for latex. Patients with latex allergy had required mechanical ventilation for an average of 6.1 ± 4.1 years vs 5.5 ± 5.4 years ($p = 0.69$; not significant) in those without latex allergy. Eleven of 17 patients (64.7%) had elevated serum IgE levels in the group with latex allergy vs only 14 of 40 patients (35.0%) in the group with a negative latex RAST ($p = 0.04$; odds ratio, 3.4).

Conclusion: We conclude that there is a high incidence of latex allergy in children requiring home mechanical ventilation. We speculate that screening all children receiving home mechanical ventilation may lead to the identification of patients with previously undiagnosed latex allergy and the prevention of untoward reactions from exposure to latex.

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Key words: home mechanical ventilation; IgE; latex allergy; radioallergosorbent test

Abbreviations: NS = not significant; RAST = radioallergosorbent test

Latex is a substance isolated from the sap of the rubber tree, *Hevea brasiliensis*. Type I (immediate) hypersensitivity reactions to latex are caused by the cross-linking of latex protein-specific IgE antibodies on mast cells and basophils, resulting in the release of histamine and other inflammatory mediators.¹ Alenius et al² identified 57 polypeptides within latex that bound IgE from patients with latex allergy. Clinical symptoms of latex allergy may range from localized pruritus to anaphylaxis.

The prevalence of latex allergy in the general population is approximately 0.1 to 1.0%.³ However,

in patients with spina bifida and other chronic medical conditions associated with repeated exposure to latex, the prevalence may be as high as 60%.⁴ More than 40,000 medical and household products are made from latex.⁵ Medical supplies containing latex range from suction catheters to latex-coated tongue blades. As a result, children receiving home mechanical ventilation are frequently exposed to latex examining gloves and other products containing latex during hospitalizations, surgical procedures (*ie*, tracheostomy placement or bronchoscopy), and multiple episodes of suctioning each day. Therefore, children requiring home mechanical ventilation may be at higher risk for latex allergies than the general population. The aim of this investigation was to determine whether ventilator-dependent children are at increased risk for latex allergy.

MATERIALS AND METHODS

Fifty-seven children receiving home mechanical ventilation were enrolled between June 15, 1998, and January 1, 2000. The

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study was approved by the institutional review board at Childrens Hospital Los Angeles, and informed consent was obtained from the study subjects or their guardians. The enrollment criteria consisted of requiring positive-pressure home mechanical ventilation through a tracheostomy for > 2 months, absence of immunodeficiency, no treatment with oral corticosteroids in the preceding 2 months, and no prior serologic evidence of latex allergy. Data collected included the patient's sex, age, number of years requiring mechanical ventilation, history of symptoms temporally related to latex or cross-reactive fruit exposure (skin rash, rhinoconjunctivitis, bronchospasm, or anaphylaxis), and diagnosis necessitating mechanical ventilation. On enrollment in the study, a serum IgE and radioallergosorbent test (RAST) for latex was obtained from all patients. Latex-specific IgE was measured using the CAP assay (Pharmacia Biotech; Uppsala, Sweden). Results of the CAP assay are reported on a scale of 0 to VI, with any level $\geq$ II considered to be indicative of the presence of latex allergy. The CAP assay has been reported to have a sensitivity of 97 to 100%.^{6,7} The Student's *t* test, χ^2 , and Fisher's Exact Test were used for data analysis. Statistical significance was set at $p < 0.05$. All patients with evidence of latex allergy were provided with educational materials and instructions for latex avoidance.

RESULTS

A RAST for latex and serum IgE were obtained in all 57 patients (31 boys, 26 girls; mean [$\pm$ SD] age, 7.8 ± 6.6 years; range, 0.3 to 23.2 years). Seventeen patients (29.8%) were found to have a positive RAST for latex. The positive RASTs for latex ranged from class II to class V (Table 1).

The diagnoses of the patients studied were central hypoventilation (17), neuromuscular disease (21), chronic lung disease (13), and restrictive lung disease (6). Four of 17 patients (23%) had central hypoventilation, 7 of 21 patients (33%) had neuromuscular disease, 4 of 13 patients (31%) had chronic lung disease, and 2 of 6 patients (33%) had restrictive lung disease and had a positive result of the RAST for latex ($\chi^2 = 0.486$; $p = 0.9$; not significant [NS]).

There were a total of 33 patients with gastrostomy tubes. There were 7 of 12 patients (58.3%) with gastrostomy tubes who had a positive result of the RAST for latex. This was not significantly different

from the 26 of 40 patients (65.0%) with gastrostomy tubes who had a negative result of the RAST for latex ($p = 0.74$; odds ratio, 0.75).

Of the patients with a positive result of the RAST for latex, 11 of 17 patients (64.7%) had elevated serum IgE levels. However, only 14 of the 40 patients (35.0%) with a negative result of the RAST had elevated IgE levels ($p = 0.04$; odds ratio, 3.4).

There were a total of 22 patients who complained of clinical symptoms temporally related to latex exposure. The clinical symptoms in descending order of frequency were rhinoconjunctivitis (18 patients), pruritus or rash (7 patients), bronchospasm (2 patients), and anaphylaxis (1 patient). The patient who experienced anaphylaxis and the two patients who had bronchospasm all had class IV result of the RAST for latex. No patient complained of symptoms temporally related to exposure to fruit. However, 25 of 57 patients (43.9%) in the study only received enteral formula via gastrostomy tubes for nutrition and were never exposed to fruits. Another 8 of 57 patients (14.0%) received the majority of their nutrition via enteral formulas and had only limited exposure to fruits. Symptoms were present in 12 of the 17 patients (70.6%) with latex allergy, but only in 10 of the 40 patients (25.0%) without latex allergy ($p = 0.002$; odds ratio, 7.2; Table 2). In a review of outpatient charts, 17 of 57 patients (30%) had allergies (either environmental or a history of atopy or allergic rhinitis) present on their problem list before evaluation for latex allergy.

All patients with evidence of latex allergy were provided with educational materials and instructions for latex avoidance. After the establishment of a latex-free environment, 7 of 12 patients (58.3%) experienced a reduction of symptoms.

The mean age of children requiring home mechanical ventilation with a positive result of the RAST for latex was 6.9 ± 4.3 vs 8.2 ± 7.4 years ($p = 0.49$; NS) in patients with a negative result of the RAST for latex. Patients who tested positive for

Table 1—Latex Reactivity by Class

Class*	RAST, % Reactivity	Patients, No.
0	< 60	34
0-I	60-70	1
I	71-110	5
II	111-220	3
III	221-600	5
IV	601-2,000	7
V	2,001-6,000	2
VI	> 6,000	0

*Considered latex allergic for class $\geq$ II.

Table 2—Correlation of Symptomatology

Symptom	Positive RAST	Negative RAST	p Value	Odds Ratio*
Any	12 of 17 (70.6%)	10 of 40 (25.0%)	0.002	7.2
Rash	6 of 17 (35.3%)	1 of 40 (2.5%)	0.002	21.3
Rhinoconjunctivitis	9 of 17 (52.9%)	9 of 40 (22.5%)	0.03	3.9
Anaphylaxis	1 of 17 (5.9%)	0 of 27 (0.0%)	0.39†	5.0

*Odds ratio for a 95% confidence interval.

†NS.

latex allergy had required home mechanical ventilation for an average of 6.1 ± 4.1 years in comparison to 5.5 ± 5.4 years ($p = 0.69$; NS) in those without latex allergy. The youngest patient with latex allergy was 1.5 years of age. This patient had a positive RAST for latex after only 10 months on home mechanical ventilation. This was the shortest interval between the initiation of home mechanical ventilation and a positive RAST for latex.

DISCUSSION

Latex allergy can have significant clinical consequences. As of September 1992, 1,100 anaphylactic reactions (including 15 deaths) had been reported to the US Food and Drug Administration.⁸ One of the patients in our study had an anaphylactic reaction to latex gloves during a surgical procedure. Children receiving home mechanical ventilation are exposed to medical supplies containing latex on a daily basis. The aim of this study was to determine whether children receiving home mechanical ventilation are at increased risk for latex allergy.

The diagnosis of latex allergy can be made both by skin testing and by latex RAST. Serologic evaluation for latex allergy was chosen in this study because it is less time-consuming and obviates the rare, but potential, possibility of an immediate, systemic reaction to skin tests. Also, several of our patients receiving home mechanical ventilation are atopic, and their chronic antihistamine therapy makes it difficult to perform skin tests. Although several studies have found the CAP assay by Pharmacia Biotech to be less sensitive or specific than skin testing,^{9,10} this assay was chosen because of its sensitivity of 97 to 100% and its acceptable specificity (83%) in high-risk populations.^{6,7} This CAP assay is able to provide reliable results for IgE levels as low as 0.35 kU/L.¹¹

As speculated, there was a significant proportion (29.8%) of children receiving home mechanical ventilation who had positive RASTs for latex. This proportion was significantly greater than expected, considering that the prevalence of latex allergy in the general population is 0.1 to 1%.³

A high proportion of latex allergy has been reported in patients with other chronic medical conditions. High rates of latex allergy have been reported in patients with spina bifida, urogenital anomalies, VATER (vertebral defects, anal atresia, tracheoesophageal fistula with esophageal atresia, and radial and renal abnormalities) association, cerebral palsy, spinal cord injury, quadriplegia, ventriculoperitoneal shunts, and multiple surgeries.¹²⁻¹⁵ However, there were no significant differences between medical diagnoses and the frequency of latex allergy in our

study. The frequency of a positive latex RAST was equal in all four diagnostic groups. All patients in the study were ventilator-dependent and likely to have frequent exposure to latex medical products. No diagnostic group would have an increased exposure and higher prevalence of latex allergy. Therefore, the development of latex allergy is more likely related to the circumstances associated with the need for mechanical ventilation rather than the underlying diagnosis. The presence of a gastrostomy tube for enteral feedings also was not associated with a higher prevalence of latex allergy.

A positive RAST for latex was significantly associated with an elevated serum IgE. This probably reflects the degree of atopy within this population. The association between atopy and the development of latex allergy, as reported in patients with spina bifida, patients undergoing multiple surgeries, health-care workers, and obstetric patients.¹⁶⁻¹⁹ Overall, 30% of the patients studied had a history of allergies (either environmental or a history of atopy or allergic rhinitis), which was similar to the incidence of allergy and atopy reported in a large study evaluating 10,000 patients before anesthesia (22%).²⁰

Of the patients with positive latex RASTs, 70% complained of clinical symptoms that were temporally related to latex exposure. This contrasted with clinical symptoms being present in < 25% of patients with a negative RAST for latex. This difference reached statistical significance. Of note, more than half of the patients experienced a reduction of symptoms after the establishment of a latex-free environment.

Interestingly, none of the patients complained of clinical symptoms after exposure to cross-reactive fruits. In the literature, latex proteins often cross-react with proteins found in many fruits such as bananas, kiwis, papayas, apricots, and avocados.²¹ One reason explaining why there were no reported symptoms after exposure to fruit is that 43% of the patients studied were fed only by enteral formulas, and were never exposed to fruits. Another 14% received the majority of their nutrition via enteral formulas and had limited exposure to fruits. Because of a lack of reported symptoms with exposure to fruits, the patients in our study were not tested for food allergies.

Five patients with positive latex RASTs did not report any clinical symptoms. They may represent either false-positive tests or an indicator of early latex allergy. Even when these five patients are omitted from the results, there remains a significant proportion (21.1%) of patients with clinical and serologic evidence of latex allergy.

There was no statistical difference in mean age between the group with latex allergy and the group

without. Theoretically, the longer a patient requires mechanical ventilation, the more he or she will be exposed to latex-containing medical products. However, in our study, there was no difference between the duration of mechanical ventilation between the group of patients with positive latex RASTs and those with negative latex RASTs. One patient had a positive RAST for latex after 10 months of mechanical ventilation, whereas another patient had a negative RAST for latex despite 23 years of mechanical ventilation.

The time course required from initial exposure to the development of latex allergy is unknown.²² However, patients with myelomeningocele have been reported to acquire sensitization to latex after a single exposure. In this study, serial measurements of latex RAST were not obtained. The shortest period from the initiation of home ventilation to the identification of latex allergy was 10 months. Unfortunately, at what point this patient developed latex allergy cannot be determined. A confounding factor is that the length of exposure to latex is often uncertain. Many of these patients are exposed to latex at the onset of respiratory failure and while the decision to transition to long-term mechanical ventilation is being made. The patient who had an allergy to latex after 10 months of home mechanical ventilation had clinical symptoms when the RAST for latex was obtained. It is our opinion that patients with clinical symptoms after exposure to latex should be evaluated for latex allergy regardless of the duration of home mechanical ventilation.

CONCLUSION

We conclude that there is a significant incidence of latex allergy in children requiring home mechanical ventilation. Although patients with an elevated serum IgE may have an increased risk of latex allergy, the total length of mechanical ventilation or the underlying disorder responsible for the need for mechanical ventilation does not correlate with the frequency of latex allergy.

Therefore, clinicians should keep a high index of suspicion of latex allergies in children on home mechanical ventilation. We speculate that patients requiring home mechanical ventilation would benefit from periodic assessment for latex allergy, especially if they have symptoms after exposure to latex. Furthermore, identification of latex allergy may be of particular importance before elective surgery.

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