
Latex hypersensitivity in emergency medical service providers

Ghassan S Safadi, MBBS*; Ellen C Corey, MD†; James S Taylor, MD‡; William O Wagner, MD*; Lily C Pien, MD*; and Alton L Melton, Jr, MD*

Background: Emergency medical service providers have a high degree of exposure to latex products. Patients utilizing emergency medical services can be allergic to latex products used during rescue efforts.

Objective: To determine the prevalence of latex hypersensitivity among emergency medical service providers.

Methods: Study questionnaires were distributed to a group of emergency medical service providers. Skin prick testing was performed using latex, common aeroallergens, and food extracts. Patch testing was done using latex and individual rubber additives. Serum latex-specific IgE was also measured.

Results: A total of 93 completed surveys were collected. Average exposure to latex in the work environment was 8.2 years. Eighty-four (90%) used latex gloves routinely at work. Of those, thirteen (14%) gave history of reaction to latex gloves. Sixty-two percent were not aware of the possibility of latex allergy in themselves or their patients. Forty-one (44%) had skin testing. Of those, four (10%) had positive prick tests for at least one of the four latex preparations used. Five had positive skin tests to avocado extract without supporting clinical history. Two had positive skin tests to banana, one with supporting clinical history for banana allergy. No food cross-reactivity with latex was demonstrated. Latex-specific serum correlated with prick skin test results. No positive reactions were noted with patch testing.

Conclusions: A significant percentage of emergency medical service providers were not aware of the occupational risk of latex allergy or the potential risk in their patients. A positive prick skin test for latex was present in 4 of 41 (10%), representing one-third of those who reported symptoms from latex exposure.

Ann Allergy Asthma Immunol 1996;77:39–42.

INTRODUCTION

Natural rubber latex is derived from the milky sap of the rubber tree, *Hevea brasiliensis*. During manufacturing, accelerators and antioxidants are added to shorten the heating time required and provide more stability to the final product. Regular contact with latex-containing products, especially rubber

gloves, can result in adverse reactions. A rise in reports of reactions from latex among health care professionals coincided in the late 1980s with the dramatic increase in the use of latex gloves due to the introduction of the Occupational Safety and Health Administration (OSHA) regulations.^{1,2}

Emergency medical service providers can come into contact with latex through commonly used emergency medical equipment particularly sterile and non-sterile gloves (Table 1). This exposure places emergency medical service providers at risk for development of latex allergy. In addition, emergency medical service providers are involved in rescue efforts of latex-allergic patients, and as such should be aware of the need for avoidance of latex products in these patients.

In this study we assess both the level of awareness and the prevalence of latex hypersensitivity in emergency medical service workers, as we are unaware of any similar studies in this group of health care professionals.

MATERIALS AND METHODS

Study Questionnaire

The study was approved by the Institutional Review Board of the Cleveland Clinic Foundation, City of Cleveland Emergency Medical Service, and the local Emergency Medical Service Workers' Union. Study questionnaires were distributed to all emergency medical providers of the city of Cleveland who attended a pre-scheduled in-service on chest pain management. The data collected was used to assess the level of awareness of latex allergy, the degree and duration of exposure to latex products, particularly gloves. In addition, other risk factors including past surgeries and history of atopy were measured.

Skin Prick Test

Skin testing was performed on all consenting participants. Testing was done by the epicutaneous method on the forearm with three different groups of allergens. These consisted of latex preparations, common aeroallergens, and food extracts.

Four latex skin test materials were prepared locally for research purposes: (1) Unmodified powdered sterile latex glove (1994 Triflex, Baxter Health Care Corp., Valencia, CA) was used for direct testing. A drop of albumin/saline solution was placed on both sides of a 1 cm² piece of glove to facilitate contact with the skin, followed by a prick-through. (2) High-ammonia latex concentrate (Ex: B-5/1, lot: 412; 1993 Goodyear Tire Co., Ak-

From the *Section of Allergy and Immunology, and the Departments of †Emergency Medicine, and ‡Dermatology, The Cleveland Clinic Foundation, Cleveland, Ohio.

Funding provided by: The Cleveland Clinic's Allergy & Immunology Research Fund and Research Protocol Committee.

Received for publication September 25, 1995.

Accepted for publication in revised form January 6, 1996.

Table 1. Common Emergency Medical Service Equipment Containing Latex

Latex gloves (sterile, non-sterile, "hypoallergenic," powder-free)
Nasal airways
Oxygen mask straps
Non-rebreather mask one-way valves
Bag-valve-mask apparatus
Endotracheal tube cuffs
Multidose medication vials
Tourniquets
Latex injection ports on intravenous tubing
Urinary catheters
Stethoscope (black rubber) and blood pressure tubing
Gas mask (personal protective equipments)
Medical antishock trousers (pump, tubing)

ron, OH) was used unmodified. (3) Crude latex extract was prepared from 1-cm² pieces of latex glove (Triflex). These were incubated on an orbital shaker in 1:5 wt/vol phosphate buffered saline (PBS), pH 7.0, at 4°C for 72 hours. The supernatant was lyophilized, reconstituted at 1 mg/mL, filtered with 0.22-μm filters, and used for skin testing. (4) Non-ammoniated latex extract was prepared from buffered *Hevea brasiliensis* concentrate shipped on dry-ice from Costa Rica. Non-ammoniated latex extract was treated with mild detergent and centrifuged at 50,000 *g* at 4°C overnight. The soluble fraction was then dialyzed against 1 mM NH₄HCO₃ using a 6,000 to 8,000-dalton molecular weight-cut-off dialysis tubing (Spectrapor; Spectrum Medical Industries, Inc., Los Angeles, CA) and freeze-dried. The lyophilized material was reconstituted in PBS, pH 7.0 at 100 mg/mL, filtered as above, diluted to 1 mg/mL, and used for skin testing.

Total protein content of the non-ammoniated and crude latex preparations was done according to the Folin-Lowry method³ with bovine serum albumin as standard. Optical density was measured at 750 nm. Immunoblots using pooled latex-allergic patient's sera confirmed the presence of IgE detectable protein bands ranging in molecular weight from 10,000 to >200,000 daltons in both the non-ammoniated and crude latex preparations prior to testing.

The aeroallergens [cat dander (*Felis domesticus*), oak (*Quercus velutina*),

timothy grass (*Phleum pratense*), mold (*Alternaria tenius*), dust mite (*Der-matophagoides farinae*), and short rag-weed (*Ambrosia artemisiifolia*), and the food extracts [avocado, banana and chestnut] were standard commercial preparations (Hollister-Stier, Spokane, Washington). Histamine phosphate 1 mg/mL was used as positive control, and albumin-saline solution as negative control (Hollister-Stier, Spokane, Washington).

A sterile bifurcated needle was used for testing (Allergy Labs of Ohio, Inc, Columbus, OH). Skin testing was read 15 minutes after application. Results were considered positive if the largest wheal diameter was 50% or greater than that of positive control and at least 3 mm larger than negative control. All measures to treat adverse reactions were readily available.

Patch Tests

Patch testing was performed on those with symptoms related to use of latex gloves or those with histories of hand dermatitis. The testing materials included rubber additives [mercaptoben-zothiazole mix, black rubber mix, thiuram mix, carbamate mix, mixed di-alkylthiourea], dried ammoniated latex (Goodyear), and a 1-cm² piece of the powdered latex glove used by emergency medical service providers (1994, Digit-Safety, Digitcare Corp., Beverly Hills, CA). The patch tests were applied to the upper back and removed 48 hours later. Sites were inspected for erythema and dermatitis at 48 and 72 hours after application.

Latex-Specific IgE

Blood was obtained by peripheral venipuncture from all consenting subjects (total = 41). Serum was separated and analyzed for latex-specific IgE using the Pharmacia CAP system.

RESULTS

Ninety-three completed surveys were collected during May, 1995, representing 85% of 110 emergency medical service providers who attended a pre-scheduled in-service on chest pain management (Table 2). The average number of years of latex exposure was 8.2 years. Eighty-four (90%) used latex gloves regularly at work. Significant histories of atopy and past surgery were noted in 34 out of 93 (37%), and 44 out of 93 (47%), respectively. Two-thirds (67%) were not aware of the risk of latex allergy in themselves or their patients.

Histories of reactions to latex and latex prick results are summarized in Table 3. Thirteen (14%) had had hand symptoms after wearing latex gloves. Four individuals had positive prick skin tests to latex (Table 4). All four with positive latex skin prick tests experienced localized itching and hives when wearing latex gloves. One paramedic also had eyelid swelling, eye watering, rhinitis and distant hives, but no other systemic or lower respiratory tract symptoms with latex exposure. Hand itching, redness, and skin cracking were reported by nine other EMS providers who otherwise had negative prick and patch tests to latex. In the four with positive latex skin prick tests the latex glove prick-through and the non-ammoniated latex extract were positive in all four, the ammoniated concentrate was positive in three, and the crude latex extract was positive in only two. Latex-specific serum IgE was positive in all four with positive skin tests to latex.

Among non-latex test materials, reactions to short ragweed were the most common (19/41), followed by dust mite and timothy grass. Five had positive skin tests to avocado extract and two had positive skin tests to banana. Only one individual (latex prick test

Table 2. Characteristics of Study Group

Occupation (total = 93)	
Paramedic	50
Emergency medical technician	32
Field supervisor	1
Office staff	4
Dispatch	2
Other	4
Age, yr*	32.3 ± 6.7
Sex	
Male	71
Female	22
Latex exposure	
Regularly use latex gloves at work	84/93 (90%)
Years of exposure to latex	8.2 ± 4*
Hours worked per week	41.3 ± 8.7*
Past surgery	44/93 (47%)
Positive history of atopy	34 (37%)
Hay fever	22
Asthma	6
Eczema	4
Drug allergy	8
Food allergy	8
Recurrent sinusitis	10

* Mean ± 2 SD.

negative) had a clinical history of banana allergy in the form of generalized urticaria and gastrointestinal symptoms following ingestion. No food cross-reactivity with latex was demonstrable in this individual. There was no clinical evidence of hand dermatitis in the form of skin cracking, fissuring, weeping, or dryness in any of the par-

ticipants at the time of enrollment. Patch testing with rubber additives, 1-cm² pieces of latex gloves, and dried ammoniated latexes, was done on those with hand symptoms. All patch test results were negative.

DISCUSSION

Although skin irritation is the most common symptom resulting from latex glove use, two types of true allergic reactions may occur following prolonged exposure.⁴ The first type is a cellular inflammatory reaction that manifests as hand dermatitis 6 to 72 hours following contact and is mostly due to additives in latex products.^{5,6} The second type develops within minutes after contact and is due to an IgE-mediated release of histamine and other mediators from primed mast cells.⁷ This immediate hypersensitivity reaction can vary from localized hand symptoms such as itching and urticaria, to a milieu of systemic symptoms including generalized urticaria, sneezing, tearing, cough, wheezing, hypotension and shock.^{8,9}

In this study, thirteen (14%) of the emergency medical service providers surveyed had symptoms related to occupational exposure to latex (Table 3). Latex skin-prick testing and latex-specific IgE measurement were positive in four (10%), all of whom were symptomatic. Negative patch test reactions excluded the presence of delayed hypersensitivity to latex itself or to rub-

ber additives in those who reported hand symptoms related to latex exposure.

Food cross-reactivity between latex and other fruits, especially banana, avocado, and chestnut, has been reported recently.^{10,11} In this group, five individuals had positive skin test to avocado extract but none was clinically significant. Two had positive skin tests to banana, one with supporting clinical history for banana allergy but without any evidence of latex allergy.

CONCLUSIONS

Emergency medical service providers in this study have a 10% prevalence rate of latex allergy as confirmed by latex skin-prick testing, similar to what is seen in other health care professionals.^{12,13} In addition, emergency medical service providers are involved in rescue efforts of patients who may have, or are at risk for the development of latex allergy. Increasing the level of awareness of latex allergy in this group of health care professionals should help prevent inadvertent reactions in those at risk. In order to allow for easy identification in an emergency situation, all latex-allergic individuals should be advised to wear a Med-Alert label. Furthermore, latex alternatives should be readily available in all emergency medical service vehicles.

Individuals may develop or experience allergies to medications, foods, and sometimes products in their work envi-

Table 3. Histories of Reactions to Latex and Results of Prick Skin Testing with Latex

	Paramedic (n=50)	Emergency Medical Technician (n=32)	Field Supervisor (n=1)	Office Staff (n=4)	Dispatch and Other (n=6)
Hand symptoms					
Irritation, dryness, redness	7(3)*	5(1)*	1	—	—
Itching, swelling	5(3)*	3(1)*	—	—	—
Localized hives	3(3)*	1(1)*	—	—	—
Upper respiratory symptoms					
Sneezing, rhinitis, eye watering	1(1)*	—	—	—	—
Systemic reactions					
Distant hives	1(1)*	—	—	—	—
Cough, wheezing	—	—	—	—	—
Dizziness, shock	—	—	—	—	—
Total (=13)	7	5	1		

* Four of the thirteen with histories of hand symptoms had positive latex prick skin test results. Of the four, one paramedic also had upper respiratory symptoms and distant hives following latex exposure.

Table 4. Characteristics of Latex Prick Test-Positive Emergency Medical Service Providers

	Latex-Allergic Individuals			
	1	2	3	4
Occupation	Paramedic	Emergency Medical Technician	Paramedic	Paramedic
Age, yr/sex	33 / female	32 / male	26 / female	38 / male
Latex exposure				
Regularly use latex gloves at work	YES	YES	YES	YES
Years of exposure to latex	7	8	6	11
Hours worked per week	44	40	48	40
Past surgery	1 Cesarean section	—	1 delivery	1 herniorrhaphy
History of atopy	eczema	hay fever	hay fever drug allergy	asthma

ronment. The implementation of generalized blood and body fluid precautions for medical workers has increased the use of latex gloves dramatically and has coincided with an alarming rise in the prevalence of latex allergy among professionals who use them. The lack of regulatory efforts as to the amount of latex allergens present in the final product, in the face of rising demand, has compounded the problem further by allowing the widespread use of high-allergen latex. The implementation of control measures setting a limit on latex products' allergen content and the use of non-latex alternatives are ways to control the rising prevalence of this medical problem. Although the direct cost of non-latex alternatives, like nitrile, remain higher than their latex counterparts, the cost of workers' compensation, disability, loss of work and medical treatment for the disease induced by latex-containing materials should also be included in the cost equation. As for now, latex allergy remains a significant medical problem that requires special consideration in emergency situations.

ACKNOWLEDGMENT

The authors thank Dale Barkhurst, EMS Coordinator at the Cleveland Clinic Foundation; Mary Craig, RN,

Emergency Department; Phyllis Evey, RN and Podjane Praditsuwan, MD, from the Department of Dermatology, for their help with coordinating the study and performing the patch testing, respectively. We also like to thank Dr. Katrina Cornish, United States Department of Agriculture, for providing us with the non-ammoniated latex concentrate.

REFERENCES

1. Fisher AA. Allergic contact reactions in health personnel. *J Allergy Clin Immunol* 1992;90:729-38.
2. Bubak ME, Reed CE, Fransway AF, et al. Allergic reactions to latex among health-care workers. *Mayo Clin Proc* 1992;67:1075-9.
3. Lowry OH, Rosebrough NJ, Farr AL, et al. Protein measurement with Folin phenol reagent. *J Biol Chem* 1951;193:265-75.
4. Slater JE. Allergic reactions to natural rubber. *Ann Allergy* 1992;68:203-9.
5. Themido R, Brandao FM. Contact allergy to thiurams. *Contact Dermatitis* 1984;10:251.
6. Wyss M, Elsner P, Wuthrich B, Burg G. Allergic contact dermatitis from natural latex without contact urticaria. *Contact Dermatitis* 1993;28:154-6.
7. Fuchs T, Wahl R. Immediate reactions to rubber products. *Allergy Proc* 1992;13:61-6.

8. Jaeger D, Kleinhans D, Czuppon AB, Baur X. Latex-specific proteins causing immediate-type cutaneous, nasal, bronchial, and systemic reactions. *J Allergy Clin Immunol* 1992;89:759-68.
9. Ownby DR, Tomlanovich M, Sammons N, McCullough J. Anaphylaxis associated with latex allergy during barium enema examinations. *Am Roentgenol* 1991;156:903-8.
10. Rodriguez M, Vega F, Garcia MT, et al. Hypersensitivity to latex, chestnut, and banana. *Ann Allergy* 1993;70:31-4.
11. Safadi GS, Melton AL, Wagner WO. Banana anaphylaxis in latex hypersensitive health care workers [Abstract]. *J Allergy Clin Immunol* 1994;93:283.
12. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987;17:270-5.
13. Safadi GS, Safadi TJ, Terezhalmay GT, et al. Latex hypersensitivity: its prevalence among dental professionals. *J Am Dental Assoc* 1996;127:83-8.
14. Mathew SN, Melton AL, Jr, Wagner WO. Latex hypersensitivity: a case study. *Ann Allergy* 1993;70:483-6.

Request for reprints should be addressed to:
Ghassan S Safadi, MBBS
Section of Allergy and Immunology / A72
The Cleveland Clinic Foundation
Cleveland, OH 44195