

Severe anaphylaxis induced by latex as a contaminant of plastic balls in play pits

Alessandro Fiocchi, MD,^a Patrizia Restani, PhD,^c Cinzia Ballabio, PhD,^c
Gabriel R. Bouygue, MSc,^a Annalisa Serra, MD,^b Marta Travaini, MD,^b and
Luigi Terracciano, MD^a *Milan, Italy*

Background: Latex causes anaphylaxis in specific contexts among children. We present 2 cases that show that severe reactions may occur in everyday circumstances with latex as a contaminant.

Objective: Because 2 cases of severe reactions to latex suggested similar circumstances of exposure, we investigated the immediate environment in which episodes occurred.

Methods: A 5-year-old girl presented to our casualty department with anaphylaxis after playing in a ball pit filled with approximately 10-cm diameter plastic balls in an American-style fast-food outlet. Two months later, a 9-year-old boy had severe anaphylaxis followed by an asthma attack with loss of consciousness while playing in the playpen of a different outlet belonging to the same company. Latex sensitization was confirmed in both cases by means of skin prick testing, latex glove skin prick testing, and 1-glove finger testing. Immunoblotting of elutions from a ball, the natural rubber latex foam pit lining, and its polyvinyl chloride sheet were performed.

Results: In the girl's immunoblot high levels of IgE specific to Hev b 4, Hev b 7, and Hev b 2 were found. The boy's immunoblot showed positivity to Hev b 7. The polyvinyl chloride ball sample showed a high concentration of specific Hevea species allergen similar to that of the foam layer sample.

Conclusion: Severe anaphylaxis can result from contact with latex proteins as a contaminant, rather than as a component, of play area ball pits and therefore outside the reported settings. Emergency health care workers should be aware of this kind of risk. A latex-reduced environment might prevent potentially severe reactions in young customers of fast-food outlets. (*J Allergy Clin Immunol* 2001;108:298-300.)

Key words: Natural rubber latex, anaphylaxis, children, ball pits

Allergic reactions to natural rubber latex (NRL) are an increasing burden for adults and children and emergency health care providers. Spina bifida, multiple surgeries, or a history of atopy¹ are known risk factors, and avoidance measures are effective only when contact is not casual, as

Abbreviations used

ICU: Intensive care unit
NRL: Natural rubber latex
PVC: Polyvinyl chloride
PVDF: Polyvinyl difluoride
SPT: Skin prick test

in operating rooms or when playing with balloons. We present 2 instances in which exposure to NRL occurred in the recreation area reserved for children in 2 different American-style fast-food outlets belonging to the same multinational corporation in Milan, Italy. The similarity of the circumstances suggested investigation of potential environmental sources of exposure. The ball pits both children had been in were filled with hundreds of colored balls approximately 10 cm in diameter. Because of clinical presentation, the balls were first thought to be made of NRL. On investigation, both pits were found to be lined on the bottom by an NRL foam layer that was covered side-to-side with a polyvinyl chloride (PVC) sheet.

METHODS

A thorough investigation of the 2 outlets was carried out to search for potential areas of exposure after the consecutive admission of 2 patients sharing clinical presentations. In May 2000, a 5-year-old girl presented with an acute allergic reaction. She had chemosis, urticaria, sneezing, cough, hypotension, and dyspnea after playing in a ball pit for 13 minutes. After being admitted to an intensive care unit, oxygen, salbutamol, and hydrocortisone therapy were used to stabilize her to recovery within minutes. Her medical history included 2 operations for inguinal hernia and eczema, but she was not aware of having any form of allergy at the time. She underwent skin testing with inhalant and food allergen extracts from Lofarma (Milan, Italy). Although positive to grass, *Dermatophagoides farinae*, and *Dermatophagoides pteronyssinus* (2- to 4-mm wheal diameters), results of skin prick tests (SPTs) with food allergens were negative. Hyperreaction to house dust mites was diagnosed, and symptoms were attributed to exposure incurred while playing in the pit.

Two months later, a 9-year-old boy presented with urticaria, facial flush, periorbital and labial edema, cough, and dyspnea after playing in the ball pit of a different fast-food outlet of the same franchise in Milan. He had experienced an asthma attack with concurrent hypotension, culminating in loss of consciousness. He required epinephrine, chlorpheniramine, and hydrocortisone therapy in the intensive care unit. Born weighing 1.420 kg at 31 weeks of gestational age, from his first day of life to his sixth year, his surgical his-

From ^athe Department of Child and Maternal Medicine, The Melloni Hospital, ^bthe Department of Paediatrics, San Paolo Hospital, and ^cLaboratory of Toxicology, Department of Pharmacological Sciences, University of Milan, Italy.

Received for publication March 21, 2001; revised April 27, 2001; accepted for publication April 27, 2001.

Reprint requests: Alessandro Fiocchi, MD, Department of Child and Maternal Medicine, The Melloni Hospital, via Melloni, 52, Milan 20134, Italy. Copyright © 2001 by Mosby, Inc.

0091-6749/2001 \$35.00 + 0 1/87/116985

doi:10.1067/mai.2001.116985

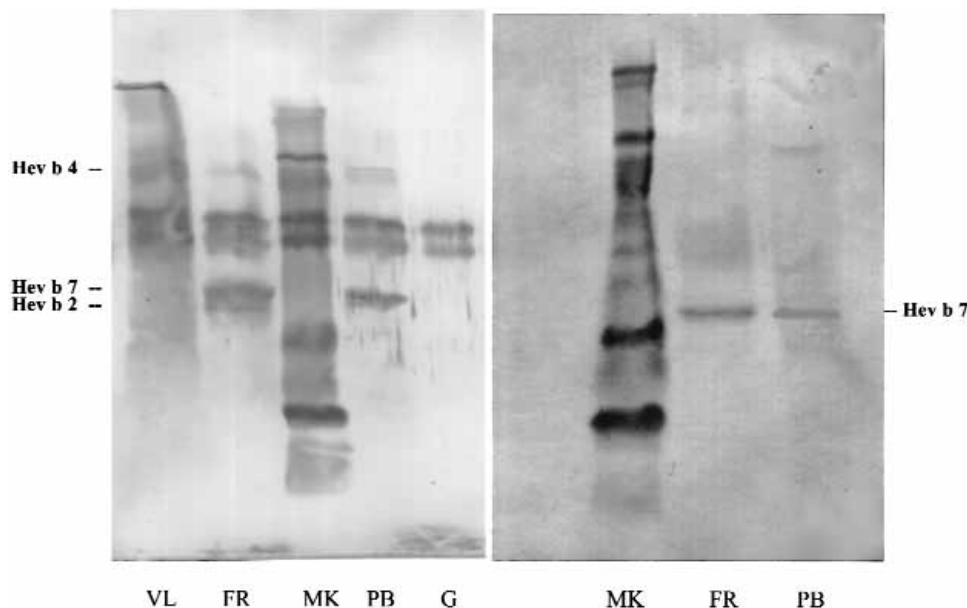


FIG 1. Immunoblotting of NRL proteins eluted from various ball pit materials. VL, Vinyl sheet; FR, foam rubber; PB, plastic balls; G, rubber glove; MK, marker.

tory included 6 procedures for the correction of esophageal atresia and achalasia and right leg palsy. However, he had no recorded history of allergic symptoms. SPT responses to birch, hazelnut, olive, and oak extracts (Lofarma) were positive with 3- to 5-mm wheal reactions. At SPT with commercial extract (Stallergènes, Paris, France), NRL elicited wheal reactions of 4 mm in diameter, and latex gloves elicited 8-mm wheals. The 1-glove finger test^{2,3} confirmed hypersensitivity and provoked symptoms of urticaria, flushes, and periorbital and labial edemas. The boy's case prompted us to recall the girl in view of the similarity of the route of exposure and circumstances.

The girl's SPT with NRL extract was strongly reactive, with a 6-mm diameter wheal. A fresh-protein latex glove SPT produced a 10-mm wheal. The 1-glove finger test again confirmed NRL allergy. The producer of the playpen materials was contacted to quantify the supposed NRL content of the pit materials. The balls turned out not to be made of NRL but rather to consist of PVC. The pits, on the other hand, are lined at the bottom with a layer of foam, the matrix of which contains NRL proteins to improve padding. This foam layer is covered by a sheet of PVC. Working on the hypothesis that whole *Hevea* species proteins might have adhered to the PVC balls through particles leaking from the rubber foam layer, samples were obtained from a ball, the NRL foam layer, and the PVC sheet from the pit. A sample from a rubber glove was used as a positive control.³ All samples were cut and soaked in 25MP Tris-HCl buffer for 48 hours. The remaining liquid was freeze-dried and resuspended in sample buffer for use at immunoblotting. The electrophoretic run was performed on a gradient (9%-19%) polyacrylamide gel, as previously described.⁴ Gels were next dyed with Coomassie Brilliant Blue G-250.⁵ Proteins were transferred from an SDS-PAGE gel onto polyvinyl difluoride (Immobilon P; Millipore, Bedford, Mass) by means of electrophoretic elution. Polyvinyl difluoride membranes were immersed in 10 mL of 0.25% gelatin solution with 0.5 mL of the patients' serum. Antigen-IgE complex was detected by using goat anti-human IgE antibodies labeled with alkaline phosphatase.

RESULTS

The PVC sheet showed an average of 15 narrow cuts, 0.9 to 3.2 mm long, 1 per square meter, in association with areas showing signs of wear. It is likely that NRL leaked through these tears and adhered to the PVC balls after repeated mechanical stresses during play. Contact between the plastic balls and the foam layer may also have occurred through discontinuities in the PVC sheet around the border of the NRL padding. In the girl's immunoblot, 2 lanes (Fig 1) were identified as proteins of about 80 and 67 kd, which is consistent with dust mite allergens. Three lanes were found at molecular weights of 115, 45, and 38 kd, respectively. These were interpreted as Hev b 4 (microhelix component, 100-110 kd), Hev b 7 (patatin-like proteins, 43-47 kd), and Hev b 2 (β -1,3 glucanase, 34-41.3 kd). The boy's immunoblot showed no positivity to dust mite allergens, but his serum reacted to Hev b 7. Lanes in both serum analyses that showed the greatest concentrations of IgE to *Hevea* species allergens are derived from the sample taken from the NRL foam. The positive control lane for the rubber glove test in Fig 1 reflects reduced antigenicity of NRL products through washing and chlorination steps during the manufacture of latex-dipped gloves.⁶ Although the PVC layer elution was not contaminated by latex, the PVC ball sample shows a concentration of specific *Hevea* species allergen similar to that of the foam rubber.

DISCUSSION

Anaphylaxis to NRL may develop in children in specific situations, such as surgery or playing with balloons, but

it has also been shown to be a food contaminant,⁷ and its allergens have been found with respirable particles in urban air samples.⁸ The 2 cases presented here document direct exposure to NRL occurring outside the home or hospital settings, and there is no other report in the literature of latex-induced anaphylaxis occurring after playing in a ball pit. A 4.4% prevalence of sensitization among children referred to an allergy department for evaluation⁶ has been reported, and NRL allergy is anything but rare, even in pediatric populations.^{8,9} They illustrate how, unbeknownst to sensitized individuals, NRL can lurk as a contaminant in PVC-sheeted play environments. We interpret this risk as 2-fold. All emergency staff should recognize that the context (a ball pit in a fast-food franchise) in which the reaction occurs does not rule out NRL as a contaminant. From emergency care workers' descriptions, hospital staff may not be aware of exposure to NRL and may consequently fail to provide the latex-free environment required to prevent potentially life-threatening reactions. Foam rubber padding has not hitherto been associated with anaphylaxis triggered by a contact or inhalant NRL allergen. We conclude that the type of play area fixture we describe raises the question of considering latex exposure in any episode of anaphylaxis. With the prevalence of atopy as high as 20% among 12- to 13-year-old children in the general population,⁷ latex should be unsuitable for play and sports area fixtures. We believe that a case can be made for playground equipment to be regularly maintained and cleaned by washing and steam sterilization.¹⁰ Given the ubiquity of latex, sensitized individuals may unknowingly be exposed to ana-

phylactic risk through dermal or inhalational exposure of aerolized NRL allergens. Latex-reduced environments for children at risk because of recreational activities may also decrease the risk of sensitization.

REFERENCES

1. Poley GE, Slater JE. Latex allergy. *J Allergy Clin Immunol* 2000;105:1054-62.
2. Frankland AW. Latex-allergic children. *Pediatr Allergy Immunol* 1999;10:152-9.
3. Hamilton RG, Atkinson NE. Validation of the latex glove provocation procedure in latex-allergic subjects. *Ann Allergy Asthma Immunol* 1997;79:266-72.
4. Restani P, Velonà T, Plebani A, Ugazio AG, Poiesi C, Muraro A, et al. Evaluation by SDS-PAGE and immunoblotting of residual antigenicity in hydrolysed protein formulas. *Clin Exp Allergy* 1995;25:651-8.
5. Neuhoft V, Arold N, Taube D, Ehrhardt W. Improved staining of proteins in polyacrylamide gels including isoelectric focusing gels with clear background at nanogram sensitivity using Coomassie Brilliant Blue G-250 and R-250. *Electrophoresis* 1988;9:255-62.
6. Beezhold DH, Sussman GL. Determining the allergenic potential of latex gloves. *Surg Services Manag* 1997;3:35-47.
7. Franklin W, Pandolfo J. Latex as a food allergen. *N Engl J Med* 1999;341:1858.
8. Williams PB, Buhr MP, Weber RW, Volz MA, Koepke JW, Selner JC. Latex allergens in respirable particulate air pollution. *J Allergy Clin Immunol* 1995;95:88-95.
9. Eseverri JL, Botey J, Cozzo M, Pena M, Marin AM. Prevalence of allergy to latex in the pediatric population. *Allergol Immunopathol (Madr)* 1999;27:133-40.
10. US Department of Health and Human Services/Occupational Safety and Health Administration Technical Information Bulletin: potential for allergy to natural rubber latex gloves and other natural rubber products. Washington, DC: US Department of Health and Human Services; 1999.