



Latex allergy: a primary care primer

MASSOUD MAHMOUDI, DO, PhD
LOREN W. HUNT, MD

Latex allergy has become an epidemic among healthcare workers. Other individuals who are frequently exposed to latex gloves or products containing latex have experienced latex hypersensitivity, as well. Identification of patients who have latex allergy is crucial to physicians in order to formulate a management plan. This article includes discussion of the basic background on latex preparation, hypersensitivity, occupational risks, and management of affected patients.

(Key words: latex allergy, hypersensitivity, occupational exposure)

What is latex? How are latex products processed?

"Rubber," coined by English chemist Joseph Priestley in 1770, was so named because of its ability to rub out pencil marks. It is found naturally by extraction from certain tropical plants, or it is made synthetically.¹ Natural rubber latex is a milky liquid extracted from a variety of plants, but mainly from *Hevea brasiliensis* (family Euphorbiaceae). Although some indications exist for the use of dry rubber, for the most part, natural rubber latex is processed. Several steps are involved to make the finished products:

- **Curing, or vulcanization**—This step, which was introduced by Charles Goodyear in the early 1840s, consisted of heating a mixture of rubber and sulfur. A cross-linking process takes place between linear hydrocarbon rubber chains. In place of sulfur, other curing agents may also be used.

At the time this article was written, Dr Mahmoudi was a senior fellow in allergy and immunology, Division of Rheumatology, Allergy and Clinical Immunology, Department of Internal Medicine, School of Medicine, University of California, Davis. Dr Hunt is a consultant, Department of Internal Medicine, Division of Allergic Disease, Mayo Clinic, Rochester, Minn.

Correspondence to Massoud Mahmoudi DO, PhD, 2211 Post St #301, San Francisco, CA 94115.

E-mail: ma0003@dnaimail.com

- **Addition of accelerators and antioxidants**—Introduction of accelerators and antioxidants in the 1900s helped to improve the curing step. Addition of accelerators such as carbamate and thiuram speed up the process of vulcanization.^{1,2} *Figure 1* summarizes the steps involved in the process of manufacturing natural rubber latex gloves.³ *Compounding* refers to the step in which chemicals such as curing agents or other materials are added.

Products made of latex

Many available latex products are used in hospitals or other healthcare facilities as well as in households. Knowledge of latex-containing products can be helpful, and at times, life saving to patients with latex allergy. Some latex-containing items such as latex gloves are easily identified by latex-allergic sufferers, but others require familiarity with the products. Latex-allergic patients should familiarize themselves with these items by asking their physicians, studying available literature, reading manufacturers' labels, contacting manufacturers for information about unlabeled items, or searching the World Wide Web. Some of the latex-containing items found in the home environment and examples of latex-safe alternatives/barriers are listed in the *Table*.⁴ Such a listing, however, is not all inclusive,

because as new products are added to market, such a list of items changes rapidly. Patients are advised to search for new items or latex substitutes periodically. Several excellent newsletters such as *Latex Allergy News* (phone: 860-482-7640; or accessed at <http://www.latexallergy-help.com>) are available.

Latex allergy—pathogenesis

The use of latex gloves has increased among healthcare workers. One of the main reasons for such an increase is the necessity of protection against hepatitis and the human immunodeficiency virus (HIV). Unfortunately, allergic levels of rubber gloves reportedly vary among different manufacturers and vary as much as 3000-fold.⁵ It has been known that natural rubber latex causes contact urticaria⁶ (type I allergy). Type IV allergy (contact dermatitis) is usually a result of additive compounds during the manufacture of latex products.^{7,8}

Patch testing can be used to identify contact dermatitis in affected individuals. In one study, 3851 patients with suspected allergic contact dermatitis were evaluated with the standard patch-test series. Among the patients tested, 145 (3.8%) were identified with a reactive patch test result. Thiuram mix was the highest reactive test, (72 %) followed by carbamix (25%).⁹

Although rare, we have reported coexistence of dual allergy to natural rubber latex, that is, types I and IV in the same individuals.¹⁰ In studies using Western blot hybridization of latex protein and serum from latex-sensitive patients who had symptoms of a type I reaction, several different molecular weight proteins are identified. Hev b3 was found as the most frequent protein isolated, followed by Hev b1, Hev b7, and a 94 kDa and a 6-8 kDa protein. Immunoglobulin (Ig) E-immunoglobulin G-1 was the most common isotope (30 of 46 samples) identified among sera tested, and the majority of them (19 of 30 samples) was also associated with IgA.¹¹ Recently, a full-length cDNA encoding the protein Hev b3 has been isolated and characterized.¹² In another study, sera of 27 patients with

Checklist

- ☐ Harvesting of protein that contains natural latex from *Hevea brasiliensis* rubber trees
- ☐ Addition of ammonia to prevent autoagglutination of natural latex
- ☐ Centrifuging and concentrating of latex from 30% to 60% solids (reduction of water-soluble proteins by removal of serum phase)
- ☐ Compounding by addition of many chemicals* to the natural latex:
 - carbamate
 - hydroxytoluene
 - mercaptobenzothiazole
 - phenol
 - phenylendiamine
 - quinalone
 - thiuram
- ☐ Removal of debris from previous cycle by cleaning porcelain hand-shaped glove formers, which are attached to a continuous chain
- ☐ Dipping of porcelain glove formers in an emulsion for application of cornstarch powder (as a releasing agent) and a compound that coagulates liquid natural latex on contact
- ☐ Oven drying of releasing agent and coagulant
- ☐ Dipping of porcelain glove formers into natural latex and deposition of a natural film
- ☐ Coagulant- and heat-conversion of natural latex from a liquid to a solid
- ☐ Rolling of cuff onto the glove by rotating brushes contacting the rotating porcelain glove formers
- ☐ Passage of glove porcelain formers through warm water baths for removal of water-soluble protein and excess additives
- ☐ Catalyzing of cross-linking of the polyisoprene polymers by heat (requiring an accelerator)
- ☐ Application of cornstarch as a detacking agent to outer surface of the natural rubber latex glove
- ☐ Stripping of gloves from porcelain glove formers

Figure 1. Steps in the manufacture of latex gloves. *Accelerators and antioxidants are among the clinically significant type IV allergens. (Source: Hamann CP. Natural rubber latex protein sensitivity in review. Am J Contact Dermatitis 1993;4:4-21.)

latex allergy were screened for IgE immune responses using an immunoblot technique. Nineteen allergenic rubber proteins in natural rubber latex were identified. The majority (17 of 27) of patients demonstrated an IgE antibody to a 20 kDa allergen. The report notes the 20 kDa rubber protein as a possible major allergen in adult patients with latex allergy.¹³

Latex proteins have been shown to bind to starch powder used in surgical latex gloves. In their study, Beezhold and Beck,¹⁴ using antilactin protein antibody, demonstrated such an interaction. Because glove powder is carried into the air, employees should not use powdered latex gloves when working in the same environment as patients with latex aller-

gy or latex-allergic coworkers.

It has been shown that some patients with latex allergy express cross-reactivity with certain foods. The most common food manifesting this cross-reactivity is banana, first reported in an atopic surgical nurse with latex allergy.¹⁵ In a different report, an atopic physician (allergic asthma) had a sensitivity to latex and banana, avocado, and peach.¹⁶ We also reported two cases of hypersensitivity with latex and banana.¹⁷ Examples of other fruit allergies in patients with latex allergy include kiwi, chestnut, and melon.⁴

Prevalence of latex allergy

The prevalence of latex allergy among healthy adults in one study was 6.4%.¹⁸ The study tested 1000 Red Cross vol-

Checklist

- ☐ Workers in latex manufacturing plants
- ☐ Healthcare workers such as
 - phlebotomists
 - nurses
 - physicians
 - dentists
 - laboratory technicians
 - other healthcare workers who are frequently exposed to latex gloves or products that contain latex
- ☐ Frequent users of latex products such as workers in industries that make latex products (for example, toy factories, medical supply manufacturers)
- ☐ Group of patients who have had multiple operations and exposures to latex gloves or latex-containing products such as patients with spina bifida
- ☐ Housekeepers and sanitarians
- ☐ Sexually active individuals who frequently use latex condoms

Figure 2. Groups at risk of acquiring latex allergy.

unteer blood donors (mean age, 37.8 years) during 1993 in southeastern Michigan. In a study of 282 pediatric patients, aged 1 to 14 years, of an allergy service, various diagnostic techniques were used to identify latex allergy. The prevalence of latex allergy varied, depending on the diagnostic test used. Prick test with latex extracts used in 185 children resulted in 2 (1.08%) positive reactions. When specific IgE blood test was used in 97 children, 7 (7.2%) had a positive reaction to latex allergen (6 of 7 were atopic). Of 282 children, regardless of techniques used, 9 (3.19%) had a positive reaction to latex.¹⁹

In a survey of latex glove manufacturing plant workers, 68 (84%) participated. Among workers who were subjected to spirometry and methacholine challenge, 3 (6%) were found to have latex-related occupational asthma.²⁰

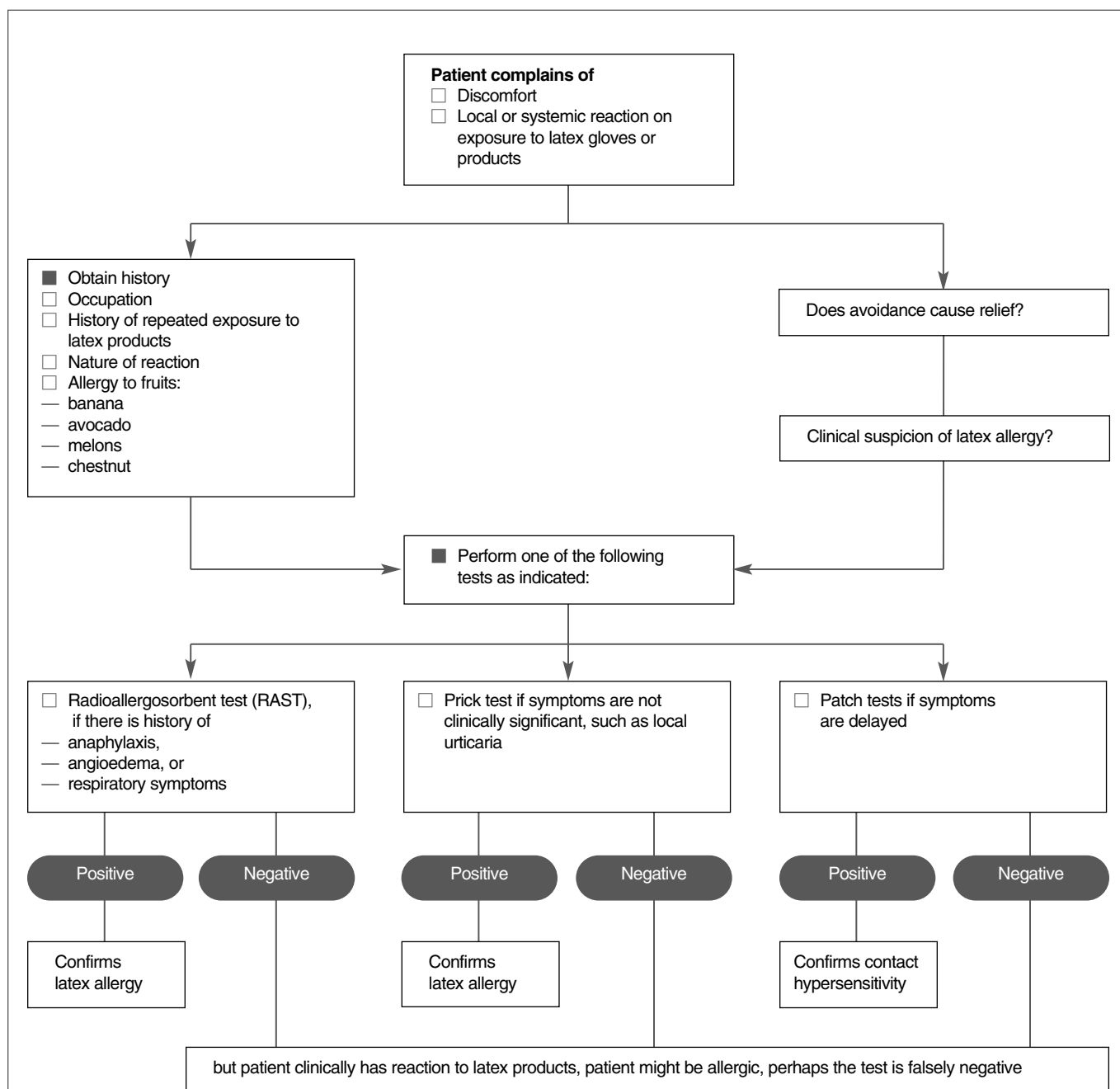


Figure 3. Algorithmic guide to diagnosis of latex allergy.

Latex allergy among healthcare workers

Prevalence of allergy to latex among employees of healthcare facilities varies.²¹ In a study at the Mayo Medical Center,²² 342 employees of the center who had reported possible latex allergy were evaluated. Diagnostic tests included skin prick test and immunoassay. Reported-ly, 100 employees (30%) were latex aller-

gic. Symptoms associated with latex exposures included contact urticaria (78%), followed by allergic rhinitis (69%), conjunctivitis (63%), contact dermatitis (45%), asthma (41%), respiratory symptoms without urticaria (15%), and systemic allergic reactions (12%).²² In a survey in Finland,²³ 512 hospital employees were screened for latex allergy; 15 (2.9%) of them were

found to have a positive reaction to latex (12 had a previous history of contact urticaria). The difference between this study and the Mayo study was that the Finnish study had surveyed all employees, whereas the Mayo study surveyed only employees who had reported symptoms of possible latex allergy.

In a study in Finland,²⁴ hospital personnel, which included nurses, cleaning

Table
Selected Latex-Containing Items Commonly Found in Daily Living and the Home Environment*

Products frequently containing latex	Examples of latex-safe alternatives/barriers
☐ Art supplies: paint markers, paints, glue erasers Problem would be liquid Friskets, and mold-making folatex; Rub-R-Mold has latex	Elmers (School Glue, Glue-All, GluColors, Carpenters Wood Glue, Sno-Drift Paste); Crayola products (except rubber stamps and erasers; Liquitex paints, Silly Putty; FarberCastle art erasers (available through Staples catalog); Dick Blick Art Materials (800-933-2542); Creative Art Products (800-945-4535)
☐ Balloons	Mylar Balloons Marketing Innovation Enterprises (212-876-6678)
☐ Balls: Koosh, tennis, rubber, basketball	PVC (Hedstrom Sports Ball)
☐ Bathroom throw rugs (nonskid latex backing)	100% cotton reversible throw rugs
☐ Bowling balls (usually house balls are 100% rubber)	Check with manufacturer
☐ Breast Self-Exam Assist	Sensor pad (Inventive Products Inc, 217-423-6911)
☐ Bungee cords	
☐ Camera eyepiece, binoculars eyepiece	
☐ Carpet backing, gym floors	Provide barrier (cloth or mat), wooden floors
☐ Chewing gum	Warner Lambert (800-223-0182)
☐ Condoms, diaphragms	Polyurethane: Female (Reality), Male (Avanti), Condomania (800-926-6399; http://www.condomania.com); Diaphragm & Pessaries Miles (Chicago, Ill; 773-736-5500)
☐ Contraceptive sponge	
☐ Cosmetic applicators (Buff Puffs)	Cotton balls, latex-free sponges (Ricky's Beauty, 212-979-5253); Cosmetic Plus, 212-319-2120
☐ Crutches-axillary, hand pads	Cover with cloth or tape
☐ Disposable diapers, rubber pants, incontinence pads	Tranquility, First Quality, Gold Seal, Huggies Kimberly-Clark Corp (Neenah, Wisc; 800-524-3577). Some Attends, Always, Drypers diapers (<i>not</i> training pants) (Houston, Tex; 713-682-3104). Adult: Confidence (Paper Pak Products; 800-635-4560)
☐ Elastic on underwear, leg and waist of clothing	Cover with cloth. Decent Exposures (800-524-4949); Special clothes for children (508-896-7939); Underwear Elastic, ARC, KidAbility
☐ Feeding nipples	Silicone (Gerber, Evenflo, MAM, some Ross, Mead Johnson), ARC
☐ Feminine sanitary pads	Kimberly-Clark products
☐ Finger cot	
☐ Fish tanks and decorations in tank (the seals for the tank are frequently latex)	
☐ Foam rubber lining of braces	Cover with felt cloth
☐ Helmets, bike	
☐ Infant toothbrush massager	Soft bristle brush or cloth, Gerber/NUK
☐ Insulation material	

Table Continued

Table, *Continued*
Selected Latex-Containing Items Commonly Found in Daily Living and the Home Environment*

Products frequently containing latex	Examples of latex-safe alternatives/barriers
☐ Kitchen cleaning gloves	Magla Home Helpers (Chatham, NJ; 800-247-5281); cotton liners, Allerderm (800-365-6868), ARC
☐ Lottery tickets ("instant winner" scratch-off is latex)	
☐ Newsprint, ads, coupons dusted with latex	
☐ Pacifiers	Plastic, silicone, and vinyl made by INFA, Gerber, MAM, binky, Kip, Soothie & Wee Soothie (Childrens Medical Venture, 800-377 3449)
☐ Plants, tarps, hose, tires, electric cords	
☐ Racquet handles: Ping-Pong, golf clubs, bats, tools, ski poles	Vinyl, leather
☐ Raincoats, rubber boots	Neoprene-coated nylon
☐ Rep Bands and Rep Cords Resistive Exercise Products	Smith & Nephew (800-558-8633)
☐ Rubber bands	String, spring clips, Plasti Band (800-247-5547), ARC
☐ Sailing equipment	
☐ Silk flowers (latex-covered stem)	
☐ Socks	Buster Brown cotton socks without elastic (Vermont Country Store, 802-362-2400)
☐ Swimming goggles, caps, bathing suits, thongs (TEVAS), caps, scuba gear	
☐ Toys, rubber ducky, teething toys	Plastic, cloth, vinyl
☐ Toys: Stretch Armstrong, old Barbie dolls, bowling balls	Jurassic Park figures (Kenner, 800-962-9888), 1993 Barbie, Disney dolls (Mattel, 800-421-2887); many toys by Fisher Price (800-432-5437), Little Tykes (800-321-0183), Playschool (800-752-9755), and Discovery; Trolls (Norfin)†; the First Years (800-533-6708), Shelcore (800-777 0453), Safety First (800-962-7233), KidAbility
☐ Weather stripping	
☐ Wheelchair cushions, tires	Jay, ROHO cushions, cover seat, use leather gloves, SofCare bed/chair cushions (Gaymar), Reliacare Express
☐ Zippered storage bags	Waxed paper, plain plastic bags, Ziploc (Dow), Glad Bags
☐ Miscellaneous —diazosensitized photocopy paper —driveway sealant —floor covering, carpet backing —gaskets —milking machines —mouse pad for computers —plasters, check labels —rubber button pads on phone, calculator, computer keyboard covers, TV remote controls —thermoplast polymers—Plexiglass, cosmetics	
☐ Clothing —crepe sole shoes, sneakers, T-shirt appliques —rubber raincoats, protective wear —stretch textiles —swimsuits	

For more complete and updated listing of Latex-containing items and information about alternatives to latex, access <http://www.latexallergyresources.org>

* Source: Latex AllergyNews. 2000;7(2):1-7.

† JC Penny and Toys R Us have catalog for special needs children with product content on most of the toys.



Checklist

■ Recommendations to patients:

- ☐ Wear a bracelet to indicate "latex allergy."
- ☐ Carry epinephrine and learn how to inject and use it in an anaphylactic situation (physicians or pharmacists should teach the patient).
- ☐ Avoid latex products.
- ☐ Substitute nonlatex gloves.
- ☐ Avoid suspected food items such as
 - banana
 - avocado
 - chestnuts
 - melons
 - other food items that cause sensitivity.
- ☐ Be aware of common latex products, and investigate the nature of unknown products that may contain latex.
- ☐ Join support groups, and follow up newsletters related to latex-allergic patients.

■ Recommendations to health-care facilities that employ or take care of latex-allergic patients:

- ☐ When a latex-allergic patient is admitted to a hospital, staff should be notified of patient's latex-allergy status.
- ☐ The sign depicting "latex-free environment" should be placed on patient's room, and nonlatex gloves, products, and equipment should be used.
- ☐ If the patient requires an operation, the operating team should be notified of patient's condition.
- ☐ Arrangement should be made for the patient to be the first case of the day to enter the operating room to avoid exposure to suspended latex powder in the operating room environment.

Figure 4. Recommendations for avoidance of exposure to latex.

staff, and laboratory technicians, were surveyed to investigate the prevalence of latex-related occupational asthma. In the study, 13 (4.7%) of 273 subjects who participated in the study had reactive skin test to latex. Other associated symptoms included glove-related urticaria (in 13), rhinoconjunctivitis (in 12), and asthma (in 5).

Who is at risk?

Workers of industries that manufacture latex products such as gloves, medical supplies, and toys are at greatest risk. Healthcare workers, including phlebotomists, surgeons, surgical nurses, dentists, physicians, laboratory technicians, and other allied health professionals who come in contact with patients or blood/bodily fluid also are at an increased risk of acquiring an allergy to latex. Those who have been frequently exposed to latex gloves and other latex products, or have had multiple surgical procedures or instrumentations such as patients with

spina bifida are also in a high-risk group. In a study of preoperative pediatric patients with spina bifida,²⁵ 11 (34%) of 32 had a positive radioallergosorbent test (RAST) to latex allergen. Such patients have many procedures throughout their life and are at risk of intraoperative allergic reactions to latex. *Figure 2* summarizes groups at risk.

Diagnosis

An algorithm for diagnosis of latex allergy is presented in *Figure 3*. Several techniques exist for determining which patients are allergic to latex. The following are the common tests:

■ **Prick skin testing**—Epicutaneous (prick) skin testing is possible; however, currently there is no standardized latex allergen extract in the United States. Therefore, the prick test is usually done with extracts prepared by individual investigators. The prick testing is not recommended in individuals who report anaphylaxis on exposure to latex.

■ **Radioallergosorbent test**—The RAST is commercially available and is recommended for patients with suspected allergy to latex who report anaphylaxis on exposure to latex. Although the RAST is highly specific, a sensitivity range of 40% to 70% has been reported.³

■ **Direct challenge**—In a direct challenge, the patient wears a partially trimmed glove to cover just one or more fingers on moistened hands. The positive reaction is determined by presence of urticarial wheals.

Treatment and recommendations

The best treatment is avoidance of reexposure. Treatment depends on severity of reaction(s) on exposure to latex. In the case of anaphylaxis, patients need to self-inject epinephrine and report to an emergency department as soon as possible. Treatment of anaphylaxis is the same as that of anaphylaxis of other causes. To avoid occupational disease, the employee with allergy to latex should wear nonlatex gloves. Individuals in the workplace of a coemployee who has latex allergy can wear latex gloves but without powder. It is the powder that allows the latex protein to become airborne. All surgical and dental procedures should be done in settings that strictly avoid latex. A Medi-alert bracelet should be worn at all times. Recommendations for patients with latex allergy or for healthcare facilities employing or taking care of such patients are summarized in *Figure 4*.

Comment

The use of latex gloves has been increasing among healthcare workers. Such an increase in the use of latex gloves and products made of latex among healthcare workers has caused an epidemic and a dilemma for some hypersensitive individuals. A survey of individuals who are frequently exposed to these products regardless of their profession is needed to identify persons who are allergic to latex. When such an allergy is determined to exist in an individual, an appropriate treatment and management plan should be enforced.

References

1. *The New Encyclopaedia Britannica*. 15th ed. Chicago, Ill: Encyclopaedia Britannica Inc; 1998:223.
2. White IR. Rubber. In: MalBack HI, ed. *Occupational and Industrial Dermatology*. 2d ed. Chicago, Ill: Year Book Medical Publishers, Inc; 1987:421-429.
3. Hamann CP. Natural rubber latex protein sensitivity in review. *Am J Contact Dermatitis* 1993;4:4-21.
4. *Latex Allergy News*. 2000;7(2):1-7.
5. Yunginger JW, Jones RT, Fransway AF, Kelso JM, Warner MA, Hunt LW. Extractable latex allergens and proteins in disposable medical gloves and other rubber products. *J Allergy Clin Immunol* 1994;93:836-842.
6. Nutter AF. Contact urticaria to rubber. *Br J Dermatol* 1979;101:597-598.
7. Rich P, Belozor ML, Norris P, Storrs FJ. Allergic contact dermatitis to two antioxidants in latex gloves: 4,4'-thiobis(6-tert-butyl-meta-cresol) (Lowinox 44S36) and butylhydroxyanisole. *J Am Acad Dermatol* 1991;24:37-41.
8. Castelain M, Castelain PY. Allergic contact dermatitis from cetyl pyridinium in latex gloves. *Contact Dermatitis* 1993;28:118.
9. von Hintzenstern JV, Heese A, Koch HU, Peters KP, Hornstein OP. Frequency, spectrum and occupational relevance of type IV allergies to rubber chemicals. *Contact Dermatitis* 1991;24:244-252.
10. Mahmoudi M, Dinneen AM, Hunt LW. Simultaneous IgE-mediated urticaria and contact dermatitis from latex. *Allergy* 1998;53:1009-1010.
11. Chardin H, Mayer C, Desvaux FX, Senechal H, Peltre G. Latex allergy: characterization of major allergens and isotypic expression. *Allergy* 1999;54:872-877.
12. Oh SK, Kang DH, Shin DH, Yang J, Chow KS, Yeang HY, et al. Isolation, characterization, and functional analysis of a novel cDNA clone encoding a small rubber particle protein from *Hevea brasiliensis*. *J Biol Chem* 1999;274:17132-17138.
13. Alenius H, Turjanmaa K, Makinen-Kiljunen S, Reunala T, Palosuo T. IgE immune response to rubber proteins in adult patients with latex allergy. *J Allergy Clin Immunol* 1994;93:859-863.
14. Beezhold D, Beck WC. Surgical glove powders bind latex antigens. *Arch Surg* 1992;127:1354-1357.
15. M'Raihi L, Charpin D, Pons A, Bongrand P, Vervloet D. Cross-reactivity between latex and banana. *J Allergy Clin Immunol* 1991;87:129-130.
16. Crisi G, Belsito DV. Contact urticaria from latex in a patient with immediate hypersensitivity to banana, avocado and peach. *Contact Dermatitis* 1993;28:247-248.
17. Mahmoudi M, Hunt LW. Hives, oral allergy syndrome, and more. *Patient Care* 1999;33:111.
18. Ownby DR, Ownby HE, McCullough J, Shafer AW. The prevalence of anti-latex IgE antibodies in 1000 volunteer blood donors. *J Allergy Clin Immunol* 1996;97:1188-1192.
19. Eseverri JL, Botey J, Cozzo M, Pena M, Marin AM. Prevalence of allergy to latex in the pediatric population. *Allergol Immunopathol (Madr)* 1999;27(3):133-140.
20. Tarlo SM, Wong L, Roos J, Booth N. Occupational asthma caused by latex in a surgical glove manufacturing plant. *J Allergy Clin Immunol* 1990;85:626-631.
21. Kujala V. A review of current literature on epidemiology of immediate glove irritation and latex allergy. *Occup Med (Lond)* 1999;49:3-9.
22. Hunt LW, Fransway AF, Reed CE, Miller LK, Jones RT, Swanson MC, et al. An epidemic of occupational allergy to latex involving health care workers. *J Occup Environ Med* 1995;37:1204-1209.
23. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987;17:270-275.
24. Vandenplas O, Delwiche JP, Evrard G, Aimont P, van der Brempt X, Jamart J, et al. Prevalence of occupational asthma due to latex among hospital personnel. *Am J Respir Crit Care Med* 1995;151:54-60.
25. Slater JE, Mostello LA, Shafer C. Rubber-specific IgE in children with spina bifida. *J Urol* 1991;146:578-579.