

Patient Safety: Latex Allergy

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Allergic reaction to the natural material latex rubber is a growing problem. The implications for hospital staff, physicians, and patients make this potentially fatal reaction a serious safety issue for all health practitioners. This article will give the historical background and the scientific basis for the reactions and summarize the various evidenced-based and practical recommendations for balancing requirements related to patient safety with the realities of the current health-care milieu.

History

Indigenous people of Central and South America, as well as Southeastern Asia, have for centuries used rubber, the milky sap of the rubber tree, *Hevea brasiliensis*. Richard Cook first used india rubber for surgical gloves in 1834 [1]. Not until Charles Goodyear developed the process of vulcanization to stabilize rubber and prevent it from easily melting or freezing, did the rubber industry become important. Although J.C. Bloodgood used gloves with his surgical team in 1893 [1], it was William Halsted in 1894 who popularized the use of gloves in surgery. Caroline Hampton, who was Halsted's scrub nurse and later his wife, developed a dermatitis from mercuric chloride used to disinfect instruments. Because of this dermatitis, Halsted required her to use rubber gloves to protect her hands [2]. Other members of his team then began to protect themselves similarly with gloves.

Not until 1928 was a process developed to dip gloves into latex, thereby producing a glove that was both stronger and thinner [1]. These gloves finally gave surgeons enough tactile sensation to become practical. Because of cost, most rubber gloves were washed, spun with powder to prevent

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sticking, and then sterilized for reuse. This practice persisted until the 1960s, when disposable gloves came into common use.

Although no randomized prospective studies have proven the efficacy of gloves, conventional wisdom requires sterile gloves for two purposes: 1) to protect the patient from microorganisms of the hands (after a cleaning solution is applied) of the team members, and 2) to protect the team from the transmission of microorganisms and viruses from the patient's blood and fluids. Because of the incidence of perforation of latex gloves (13%) the Occupational Safety and Health Administration recommends double gloving and sterile gloves for all members of the scrubbed surgical team as a Category 1B recommendation [3] after donning a sterile gown.

Latex is used in the operating room not only in the form of gloves, but in many other ways, which makes the elimination of latex problematic. Latex is found in multiple medical products, including blood-pressure cuffs, stethoscopes, oral and nasal airways, tourniquets, Penrose drains, syringes, and electrode pads, as well as in gloves, urinary drainage catheters, esophageal dilators, and ventilator connections. Even intravenous connectors are frequently latex-based. It is estimated that latex is used in 40,000 medical and nonmedical products [1], and therefore exposure to latex is almost unavoidable in everyday life.

The first scientific paper describing dermatitis from rubber gloves was published in 1933 [4]. From 1979 to 1988, multiple reports of localized reactions to gloves appeared in Europe and America. Several reports of anaphylaxis began appearing in the anesthesia literature in the late 1980s [5,6]. However, the problem of latex as an allergen was still not widely recognized. As universal precautions (now termed "standard precautions") became the norm following the recognition that AIDS and other viruses were transmitted through human fluids, the use of latex gloves accelerated. Still, knowledge and concern about latex sensitivity was minimal and the allergic reaction was frequently attributed to other sources. It has been estimated that in 1987, 1 billion gloves were imported for medical use. This grew to 20.8 billion gloves imported in 1996 [7]. In the United States, about 5.6 million health-care workers and other persons now use latex gloves daily [8].

One group identified early on as high risk for latex allergy was spina bifida patients, who frequently undergo numerous operative procedures for multiple reasons [9]. It was thought that the rise in latex-related allergies was related to the deterioration in the latex that occurred with low-quality gloves.

Latex—what is it?

Natural rubber latex is a milky fluid that is a mixture of proteins, phospholipids, and polyisoprene. Natural latex is combined with other chemicals, primarily ammonia, to enhance the natural qualities and yield commercial latex. It is postulated that the latex proteins are the major cause of the

IgE-mediated allergic reaction [10]. Added accelerators and antioxidants may also be significant mediators of the type IV (allergic contact dermatitis) allergic reaction [11].

Latex gloves, balloons, and condoms are made either by molds or by a dipping process. The softest rubber products appear to have the highest allergenic potential. The addition of cornstarch powder to gloves in 1947 to prevent sticking and give a smoother fit has been shown to increase the leaching of latex proteins and exposure of latex proteins on the surface. Cornstarch also promotes aerosolization of the latex proteins when gloves are removed. Low-protein, powder-free gloves decrease the sensitization potential of the latex and avoid some of the granuloma formation associated with powder [11].

Incidence of later allergy

Although data is difficult to obtain, estimates now indicate that 1% to 6% of the general population has some sensitivity or allergy to latex, and about 8% to 12% of health-care workers regularly exposed to latex develop sensitivity. Meanwhile, as many as 20% of operating room personnel may have developed sensitivity [12]. European studies found a 0.9% to 10% incidence of positivity to pin prick, while a Brazilian study found a 6% allergic sensitization rate [13]. Other estimates of latex sensitivity are as high as 17% [14]. Because of the explosion in the incidence of later allergy and the worldwide potential for problems, a better understanding of the problem is required for all health-care providers ([Appendix 1](#)).

Latex is ubiquitous in our society and is especially prevalent in the health professions. Exposure occurs frequently through cutaneous contact, although mucous membranes, intravenous routes, and inhalation pathways are all portals of entry. Mucous membranes, especially in the mouth, vagina, and rectum are common areas of exposure. The release of latex particles in the air is particularly dangerous to individuals who are already sensitized. Such release can lead to bronchospasm and laryngeal edema. As noted, the addition of powder to the particles makes them particularly dangerous. Outside the operating room, latex is found in elastic bands, erasers, automobile tires, bicycle handgrips, shoe soles, and pacifiers. Therefore, the incidence of latex sensitivities and allergies will likely grow.

Differentiating later allergic reactions

Reactions to natural rubber latex range from mild irritation to anaphylactic latex allergy ([Box 1](#)). Irritant contact dermatitis is the most common reaction and is evidenced by sore, red, dry, and chapped hands. This is a nonallergic reaction that is localized to the skin. Thorough washing and drying of hands, the use of powder-free gloves, and the practice of changing

Box 1. Types of latex and other glove-associated reactions

- A) Irritation: nonallergic irritation caused by hand washing, insufficient rinsing, and glove powder. Clinical signs: dry, crusty, hard bumps; sore and horizontal cracks on skin, which may itch. Treatment: avoid or remove the irritant and use nonpetroleum-based moisturizing creams.
- B) Allergic contact dermatitis: chemical allergy from exposure to chemicals in latex manufacture. Clinical signs: red, raised bumps; sore and horizontal cracks, which may extend up forearm. Signs usually appear slowly after exposure and may persist for days. Treatment: use of moisturizing creams and avoidance of petroleum-based products, which may be latex incompatible. Avoidance of latex especially important if there are breaks in the skin.
- C) Latex allergy: type I hypersensitivity from exposure to proteins in latex or suspended in air. Clinical signs: wheal and flare response within minutes of exposure under glove. May mimic irritant and allergic contact dermatitis. Severe forms include facial swelling, generalized urticaria, respiratory distress, and anaphylaxis. Treatment: immediate removal from the latex-containing environment and anaphylaxis therapy if needed.

gloves frequently to minimize sweating under the gloves can reduce skin irritation.

Allergic contact dermatitis, which may result from the chemical additives used in the glove manufacturing process, is usually localized to the area of contact. This form of dermatitis is not caused by the latex itself. Repeated exposure to the allergens can lead to increased sensitization and an increasingly severe reaction.

True latex allergy occurs when repeated sensitization to latex produces anti-latex IgE antibodies that stimulate mast cells, basophils, and histamine release. Local and systemic reactions can occur. The allergic reaction is immediate, with symptoms occurring in minutes [15]. The patient may display symptoms of urticaria, laryngeal edema, bronchospasm, and asthma. Anaphylaxis and death can occur. Basic life support should be instituted promptly to maintain the airway, breathing, and circulation. Latex-containing products should be removed promptly.

Latex-induced anaphylaxis has been reported to account for up to 17% of cases of intraoperative anaphylaxis [16]. The diagnosis and management of latex-induced anaphylaxis is reviewed in detail in a national practice parameter on anaphylaxis and summary statements are listed in Box 2 [17]. It's

Box 2. Summary of parameters for managing latex-induced anaphylaxis

- Latex (rubber) hypersensitivity is a significant medical problem and three groups are at a higher risk of reaction: health-care workers, children with spina bifida and genitourinary abnormalities, and workers with occupational exposure to latex.
- To identify IgE-mediated sensitivity, skin-prick tests with latex extracts should be considered for patients who are members of high-risk groups or who have a clinical history of possible latex allergy. Although a standardized commercial skin test reagent for latex is not available in the United States, many allergy centers have prepared latex extracts from gloves to be used for clinical testing. Such extracts, prepared from gloves, demonstrate tremendous variability in the content of latex antigen. In vitro assays for IgE are generally less sensitive than skin tests.
- Patients with spina bifida (regardless of a history of latex allergy) and other patients with a positive history of latex allergy ideally should have all medical, surgical, and dental procedures performed in a latex-safe environment and as the first case of the day.
- A latex-free environment is an environment in which no latex gloves are used in the room or surgical suite and no latex accessories (eg, catheters, adhesives, tourniquets, and anesthesia equipment) come into contact with the patient.
- In health-care settings, general use of latex gloves with negligible allergen content, powder-free latex gloves, and non-latex gloves and medical articles should be considered to minimize exposure to latex allergen. Such a combined approach might reduce latex sensitization of health-care workers and patients and should lower the risk of inadvertent reactions to latex in previously sensitized individuals.

From Joint Task Force on Practice Parameters for Allergy & Immunology. The diagnosis and management of anaphylaxis: an updated practice parameter. J Allergy Clin Immunol 2005;115:S483–523; with permission.

important to convert a latex-free environment during the resuscitation of patients with sudden intraoperative cardiovascular collapse of unknown cause. Latex must always be considered as a potential culprit, even in patients without obvious risk factors [18].

Evidenced-based information

There is no level I evidence-based data about latex-induced anaphylaxis because there is no way to design a study to look at a potentially lethal complication. On the other hand, the goal of zero tolerance is also impractical at this point. Therefore, most findings and recommendations are based on case reports and immunological findings. The recommendations are mostly class C. However, the implications of missing a possible latex allergic patient are significant. Obviously, there are important financial and practical obstacles to becoming latex-free, and each institution and surgeon needs to examine the cost/benefit ratio. However, the following recommendations have emerged from the realization that the problem is spreading and has worldwide implications.

Recommendations

The most certain way to prevent latex allergy is to eliminate latex, a solution that is nearly impossible. The goal should be education and lowering of risk to health-care practitioners and patients. Industry is rapidly responding to the problem with the introduction of latex-free gloves, intravenous needles, tubing, and other medical supplies. Eventually, the marketplace will provide solutions. In the meantime, to reduce the exposure to latex and risk of developing latex allergies in health-related fields, health-care institutions should adopt practical recommendations that protect personnel.

Preoperative screening

Screening patients is the first step for minimizing the risk of a latex allergic reaction. Practice guidelines for determining latex sensitivity are imperative to ensure that all patients are identified. Patients first should be asked if they have a confirmed latex sensitivity or allergy. Patients at special risk even without documented latex allergy are those individuals with frequent or prolonged exposure to latex products. This group can include health-care workers who have worn gloves for long periods and patients who have undergone multiple surgeries or procedures. Three groups are at higher risk of later allergic reaction: health-care workers, patients with spina bifida or genitourinary abnormalities, and workers with occupational exposure to latex. These individuals may display irritant or contact dermatitis. Allergic patients may show signs of skin rash, hives, itching, flushing, rhinitis, and shock.

Patients with a history of allergy (eg, asthma, environmental or drug allergens) or a history of unexplained anaphylaxis during surgical, dental, or interventional procedures may also be at risk. When a history of latex sensitivity is suspected, a patient questionnaire, such as the questionnaire in [Box 3](#), can be administered.

Box 3. Patient questionnaire for detecting latex sensitivity

1. Have you ever had allergies, asthma, hay fever, eczema, or problems with rashes?
2. Have you ever had anaphylaxis or an unexpected reaction during a medical procedure?
3. Have you ever had swelling, itching, or hives on your lips or around your mouth after blowing up a balloon?
4. Have you ever had swelling, itching, or hives on your lips or around your mouth during or after a dental examination or procedure?
5. Have you ever had swelling, itching, or hives following a vaginal or rectal examination or after contact with a diaphragm or condom?
6. Have you ever had swelling, itching, or hives on your hands during or within 1 hour after wearing rubber gloves?
7. Have you ever had a rash on your hands that lasted longer than 1 week?
8. Have you ever had swelling, itching, or hives after being examined by someone wearing rubber or latex gloves?
9. Have you ever had swelling, itching, hives, running nose, eye irritation, wheezing, or asthma after contact with any latex or rubber product?
10. Has a physician told you that you have rubber or latex allergy?
11. Are you allergic to bananas, avocados, chestnuts, pears, figs, papayas, or passion fruit?
12. Are you presently on beta-blockers?

Data from Association of periOperative Registered Nurses. AORN latex guidelines. In AORN: 2004 standards, recommended practices and guidelines. Denver (CO): AORN, 2004. Latex sensitivity: current issues. Healthc Hazard Mater Manage 1999;16:103–118. Catalano K. Risk management and latex allergies. Surgical Services Management 1997;42:44–6.

The National Institute for Occupational Safety and Health (NIOSH) [19] recommends steps that employers, workers, and patients can take to reduce latex exposure and to protect patients with possible allergies from undue risk. Those steps are listed in [Box 4](#):

Setting up a latex-safe operating room

Setting up a latex-safe operating room begins with educating staff about the incidence, risk factors, identification, and management of latex sensitivity.

Box 4. NIOSH steps for reducing latex exposure*Steps for employers*

1. Provide workers with non-latex gloves to use when there is little potential for contact with infectious materials (eg, food industry workers).
2. Appropriate barrier protection is necessary when handling infectious material [20]. If latex gloves are chosen, provide reduced-protein, powder-free gloves to protect workers from infectious materials.
3. Ensure that workers use good housekeeping practices to remove latex-containing dust from the workplace.
4. Provide workers with education programs and training materials about latex allergy. Post signs and materials in visible places.
5. Periodically screen workers for latex allergy symptoms.

Steps for all workers

1. Use non-latex gloves when possible, especially when not dealing with infectious materials
2. If latex barrier protection is used, choose powder-free gloves with reduced protein content [21].
3. Wash hands after removing latex-containing gloves.
4. Learn to recognize the signs and symptoms of latex allergy and report them promptly

Steps for workers dealing directly with patients

1. Urge patients to notify health-care workers of latex sensitivity.
2. Assess all patients for latex sensitivity.
3. Administer patient questionnaire (Box 3) to patients with suspected or known sensitivity.
4. Apply latex allergy band or medic alert bracelet to patients with suspected or known sensitivity.
5. Perform latex sensitivity testing on patient as indicated.
6. Advise patients that latex is present in many surgical supplies.
7. Institute basic life support to patients with allergic reaction to latex.
8. Use latex-free products for patients with suspected or known sensitivity.
9. Follow institutional latex-safe policy for patients with suspected or known sensitivity.

Adapted from the National Institute of Occupational Safety and Health (NIOSH). Latex allergy: a prevention guide. Available at: www.cdc.gov/niosh/98-113.html. US Department of Health and Human Services, 1999.

Protocols, policies, and procedures related to latex safety should be developed and implemented. Collaborating and communicating with pharmacy, dietary, and other departments can help to avoid latex exposure on, for example, drug vials and food trays. Mock latex allergy situations should be performed at least annually to maintain staff competency.

Health-care workers should identify and avoid (when possible) latex products in the operating room. Identifying alternative products and storing them away from latex products provides latex-free resources for patients suspected or known to have sensitivity. Institutions should consider purchasing latex-free procedure modules for anesthesia and surgical specialties. Developing a mobile cart containing latex-free supplies for sensitive patients facilitates a rapid response.

When a patient is identified as being latex sensitive, the latex-free case should be scheduled as the first of the day. The operating room should be cleaned (with non-latex gloves) before the patient enters the surgical suite. The operating room itself should be closed for 30 minutes after cleaning. Frequent cleaning of areas and equipment contaminated with latex-containing dust can reduce the number of ambient latex particles [21].

Staff should use latex-free gloves and thoroughly wash their hands with soap and dry after removing gloves. Nitrile (eg, polymer of butadiene, acrylonitrile, and carboxylic acid) and neoprene (chloroprene) are acceptable for prolonged exposure to blood and body fluids. Vinyl (polyvinyl chloride) does not provide sufficient barrier protection against blood and body fluids. The management of cardiac surgery patients with latex allergy can be particularly challenging, and an integrated multidisciplinary approach is necessary [22].

Cost considerations

Computing the cost of latex allergy requires a review of morbidity, mortality, and financial factors. Studies have demonstrated cost savings (One institution realized savings of \$200,000.) when converting to low-powder or powder-free gloves [23,24]. Removing latex gloves (and other latex products) altogether from a supply inventory is an option undergoing increasing scrutiny.

In a cost analysis of health-care worker disability from latex allergy and asthma, Phillips and colleagues [25] found that health-care facilities can save money by creating a latex-safe environment. In their study, they focused on the cost of replacing latex gloves with non-latex gloves. The investigators compared those costs to the payments for workers' compensation. The study calculated the value of total disability wage replacement for one employee with latex allergy at \$108,917. The cost of partial disability for one employee was \$61,988. When only the cost of gloves was considered, the latex-free approach was more expensive than the continued use of latex

Box 5. Latex-related cost considerations

Sick leave of latex-sensitive staff
Diagnostic tests to determine sensitivity
Latex-related medical care
Decreased staff productivity
Lost staff work time
Employee turnover
Workers' compensation
Cancelled or delayed surgery for latex-sensitive patients
Latex supply replacement
In-service training for staff
Time for developing policies and procedures
Regulatory accommodation (eg, compliance with Americans with Disabilities Act)

gloves. When other factors were considered (**Box 5**), the latex-safe approach was more cost-effective, even when latex disability levels were very low.

Summary

As the use of latex has increased, so has the concern over latex reactions among health-care providers. To reduce the risk to health-care personnel and patients, surgeons need to insist on powder-free gloves and be willing to use latex-free products when possible [26]. Converting operating rooms to latex-free environments may be necessary in the future. For now, however, the goals are to lessen exposure to latex-containing products and create a latex-safe environment [23]. Screening for latex allergy, educating health-care providers to the problem, and alerting patients to be aware of the possible risks are all necessary for ensuring the safety and effectiveness of the health-care system. A team approach to eliminate the problem is necessary, and surgeon buy-in is a key element of the solution. The recommendations given above can help establish a framework to minimize or prevent serious latex-related reactions.

Appendix 1. Definitions related to latex sensitivity

Allergen. A substance that can induce an allergic or specific hypersensitivity reaction; an antigen.

Allergy. An immune response to an antigen producing a symptomatic reaction in a susceptible individual.

Dermatitis. Inflammation of the skin.

Allergic contact dermatitis. (Type IV, delayed hypersensitivity) A delayed, T-cell—mediated, hypersensitivity reaction attributed to antigenic chemicals added during the harvesting, processing, or manufacturing of latex products.

Irritant contact dermatitis. Nonallergic, localized cutaneous response to a substance contacting the skin.

Latex. Viscid, milky juice secreted by the rubber tree *Hevea brasiliensis*; contains lipids, phospholipids, proteins, carbohydrates, and cis-1, 4-polyisoprene; also known as natural rubber latex.

Latex allergy. (Type I, type IgE-mediated, immediate hypersensitivity) Localized or systemic allergic response to one or more latex proteins (antigens) to which the individual has been sensitized and developed antibodies; true latex allergy.

Latex-free environment. An environment in which all latex-containing products have been removed.

Latex-safe environment. An environment in which every reasonable effort has been made to remove high-allergen and airborne latex sources from coming into direct contact with affected individuals.

Sensitization. Immunological memory in response to exposure to an antigen.

Sensitivity. Clinical expression of symptoms developing after sensitization.

Data from Association of periOperative Registered Nurses. AORN latex guidelines. In: AORN: 2004 standards, recommended practices and guidelines. Denver (CO): AORN; 2004. p. 103–18. Janeway CA, et al. The induction, measurement, and manipulation of the immune response. In: Immunobiology: the immune system in health and disease, 4th edition. New York: Elsevier; 1999, p. 33–75. American Society of Anesthesiologists Natural rubber latex allergy: considerations for anesthesiologists. Available at: <http://www.asahq.org/publicationsAndServices/latexallergy.html>. Accessed October 19, 2003. National Institute for Occupational Safety and Health (NIOSH). Preventing allergic reactions to natural rubber latex in the workplace. Available at: <http://www.cdc.gov/niosh/latexalthtml>. Accessed February 26, 2005.

Further reading

American Latex Allergy Association, www.latexallergyresources.org.

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