Natural Rubber Latex Protein Allergy Prevention and Exposure Control

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The recently documented increasing incidence of natural rubber latex (Hevea brasiliensis protein allergy (HBPA) in health care workers and the general population has led several national organizations and governmental agencies to recommend that health care organizations: modify use of latex products, particularly gloves; implement mechanisms to identify persons with HBPA; and initiate strategies to mitigate HBPA development.

To respond to this emerging challenge to patients and health care workers, the Kaiser Permanente California Division and Northwest Division developed the Western Divisions' "Latex Protein Allergy Prevention and Exposure Control Plan." This collaboratively developed plan builds on the Hawaii Division's previous work and provides information regarding 1) identification of patients and health care workers with HBPA; 2) recommendations for creation of a health care environment that is safe for patients and health care workers with HBPA; and 3) to minimize the risk of developing HPBA (latex-safe strategies). Implementation of this plan should facilitate system-wide consistency in the evaluation, management, and care coordination of health plan members and health care workers with HBPA.

As future health care issues require greater collaboration between physicians and non-physician support personnel, this collaborative effort could serve as a model for development of similar comprehensive clinical management and operational guidelines.

Introduction

The purpose of this article is to expand awareness of the problems associated with natural rubber latex (*Hevea brasiliensis*) protein allergy (HBPA) and to put the risks of inaction into context. This paper includes a review of the mechanism of HBPA, who is at risk, and how to diagnose significant HBPA. Finally, it documents what our organization is doing to create a safer work and patient care environment through the development and implementation of the Kaiser Permanente Western Divisions' "Latex Protein Allergy and Exposure Control Plan,[1]" which is available from the authors or from the Western Divisions' Latex Allergy Management Committee.

Glossary of Terms

HBPA: Hevea brasiliensis protein allergy.

Latex allergy management: Refers to all measures used to mitigate the effect of HBPA.

Latex-safe environment: Refers to an environment in which products containing latex protein or binding agents (eg, glove powder) have been eliminated and/or exposure to such products has been minimized in order to decrease the risk of latex protein allergy development or hypersensitivity reactions in persons who have HBPA.

Natural rubber latex protein allergy: hypersensitivity to the protein derived from the Hevea brasiliensis plant.

Non-latex gloves: gloves manufactured using synthetic or non-latex-containing materials.

The incidence of HBPA has dramatically increased with the widespread use of natural rubber latex gloves needed to enact the universal precautions necessitated by the HIV epidemic. In a summary produced in 1993, the United States Food and Drug Administration (FDA) reported over 1100 adverse events and 15 deaths associated with HBPA.[2] All deaths reported to date have been from parenteral exposure such as from barium enema cuffs. The most severe symptoms from routine occupational exposures reported to date are urticaria, asthma, and, very rarely, anaphylaxis.

Although only a small (<5 %) fraction of a population such as health care workers become significantly sensitized to natural latex rubber proteins and have clinical symptoms ranging from sneezing, itching, or hives to asthma and/or anaphylaxis when exposed to natural rubber latex proteins,[3,4] the costs associated with caring for such persons can be substantial. The fraction of a

"The fraction of a population that may develop serologic evidence for allergic antibody to latex rubber proteins can be 2 to 10 times higher than the fraction that actually has clinical symptoms.[5]"

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population that may develop serologic evidence for allergic antibody to latex rubber proteins can be 2 to 10 times higher than the fraction that actually has clinical symptoms.[5] Antibody-positive individuals are only potentially allergic to latex but can account for, by CDC estimates, up to 10% of the health care worker population. One measure of the difference between potential allergy and significant allergy is the lack of anaphylaxis seen during surgery. Fewer than 1 in 5000 unscreened individuals has unexplained, possibly latex-protein-induced anaphylaxis during surgery, yet a much higher fraction are antibody-positive.[6] The fraction of the general patient population that has HBPA is lower than health care workers because of lower levels of exposure to natural rubber latex proteins and is probably <3%.[7] The health care environment has historically been a significant source of latex protein sensitization for the general population.

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Natural Rubber Latex Protein

Natural rubber (cis-1,4-polyisoprene) is a processed plant product of the commercial rubber tree *Hevea brasiliensis*. It contains variable amounts of water-soluble proteins that can be recognized as allergens by the human immune system. With recurrent exposure, a certain fraction of the population can become sensitized. Synthetic latex and some rubber products lack these potentially allergic proteins, though individuals may still have problems with contact sensitization from chemical additives in processed rubber.[8] Natural rubber products from other sources, such as guayule (*Parthenium argentatum*) contain other potential but less well-studied, allergenic proteins.[9]

Mechanism of Latex Allergy

Natural rubber latex protein allergy (HBPA) is defined as an IgE-mediated (Type I hypersensitivity) reaction against water-soluble proteins contained in natural rubber products made from the sap of *Hevea brasiliensis*. Exposure to latex proteins in allergic persons causes the immediate onset of mast cell mediator release. Histamine and other preformed mast cell mediators cause acutely increased vascular permeability and tissue edema. Mast cells also contain mediators that cause delayed inflammatory effects. Immediate hypersensitivity reactions have been elicited by latex protein exposure dissolved from rubber gloves, condoms, barium enema catheters, bladder catheters, balloons, cofferdams, toys, dental prophylactic cups, and sports equipment.[7] The clinical manifestations of these reactions include itching, systemic urticaria, rhinitis, conjunctivitis, laryngeal edema, bronchospasm, hypotension, asthma, feeling of impending doom, anaphylaxis, and, if untreated, death.

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Routes of Exposure

Latex protein exposure can occur by parenteral, mucosal, inhalation, and cutaneous routes. Anaphylaxis, a systemic allergic reaction, is more likely to occur the higher the level of antigen exposure is in the circulation and the faster the dose is delivered.[3] Thus, in equivalently HBPA persons, latex protein exposure through contact from gloves on internal organs during surgery or with a latex-cuffed barium enema catheter will cause greater problems than latex protein on intact skin. The inhalation of latex proteins adherent to the inert powders from gloves can dissolve on the mucus membrane surfaces of the upper airway and cause significant allergic reactions such as allergic rhinitis and asthma.[3] Most environmental exposure to latex proteins causes reactions no more severe than cat protein exposure causes in a person allergic to cats.

Diagnosis of HBPA

The key point in the diagnosis of potentially life-threatening HBPA is the clinical history. Those who report itching, rhinitis, swelling, hives, or asthma upon latex rubber exposure or who have had unexplained anaphylaxis after medical or surgical procedures, should be screened for IgE antibodies to latex with an ELISA test. Within Southern California Kaiser Permanente, the latex ELISA test, manufactured by Upjohn-Pharmacia, is conducted by the Immunology Laboratory at the Los Angeles Medical Center under the direction of Bruce Goldberg, MD, PhD. Within the Kaiser Permanente system, the predictive value of the ELISA has been between 92% and 95%. Inquiring for a latex allergy history and sending the confirmatory test if the history is positive should become a routine part of obtaining the drug intolerance history.

If the Latex ELISA is ≥ Class 3, consider the history-positive subject to truly have HBPA. As with any test, false-negative latex ELISA tests can occur, but given the lack of a gold standard, the actual level is difficult to determine short of a diagnostic clinical challenge test. Those at risk of anaphylaxis often have very high levels of anti-latex IgE antibodies and have Latex ELISA of ≥ Class 4.[10] If a person has a negative ELISA (≤ Class 2) test, yet has a compelling clinical history of latex allergy, skin testing can be performed.[11]

There is currently no FDA-approved skin test reagent for diagnosis of latex allergy. To circumvent this problem, a quantitated latex protein solution has been produced by Eric Macy, MD, in the Allergy Department at the Claremont Mesa facility in San Diego for use within the Kaiser Permanente Health Care System. The protein content of a saline extract of raw ammoniated latex was measured and diluted to

0.01 mg/ml and 0.1 mg/ml for sequential puncture tests. If both were negative a single intradermal test using 0.001 mg/ml was used. This reagent has been safely used in more than 50 people and will identify a fraction of those who have latex ELISA ≤ 2 as producing some allergic antibody to latex proteins. Those who have low-level ELISA and positive skin test results should avoid natural rubber latex proteins, though they are extremely rare.

Populations at Increased Risk for Latex Hypersensitivity

Persons who have high levels of latex protein exposure are at increased risk for latex hypersensitivity even if they have had no clinical symptoms. Patients with a history of spina bifida and genitourinary tract anomalies, who have needed multiple surgical procedures and catheterizations, are at particularly higher risk of developing latex protein hypersensitivity, and 18% to 68% of such individuals, in the United States, reported to have some evidence for latex allergy. In contrast spina bifida patients from Venezuela who were not exposed to latex protein did not have evidence of elevated levels of HBPA.[12]

Persons such as health care workers, who have frequent exposure to latex proteins, are more likely to become sensitized than most in the population.[7] Because the rate of clinically significant reactions is much less than the rate of positive diagnostic tests, random or universal screening is not recommended.[6]

Management of HBPA Within Kaiser Permanente

The formal diagnosis of latex allergy requires both clinical symptoms upon exposure and positive confirmatory test results.[7] The 1996 American Academy of Allergy, Asthma and Immunology (AAAAI) and the 1997 National Institute for Occupational Safety and Health (NIOSH) recommendations for latex avoidance and care management are based on avoidance of latex products as the only measure that can prevent serious allergic reactions to latex.[13,14]

In response to published reports documenting an apparent increase in latex protein allergy among HCWs and patients and prior to publication of the AAAAI and NIOSH recommendations, a Latex Allergy Prevention and Exposure Management Committee was formed consisting of Kaiser Foundation Hospitals, Health Plan, and Permanente Medical Group representatives from the Northwest, and Northern and Southern California Divisions. The disciplines involved in the Committee included: Perioperative Services, Departments of Allergy and Dermatology, Nursing, Materials Management, Employee Health, Product Utilization, Laboratory, Pharmacy, Medical Center Administration, Safety, Admitting, Risk Management, physicians, and selected health care workers.

This multidisciplinary committee first met in late 1995 to assess the impact of latex protein allergy within the Kaiser Permanente Western Divisions, and initial investigations have demonstrated a prevalence comparable with the CDC estimates noted earlier. To address this situation, throughout 1996, the Committee developed a Latex Protein Allergy Prevention and Exposure Control Plan that ultimately incorporated all the essential components of the AAAAI recommendations. The plan is designed to 1) create a latex-safe environment across the continuum of care for latex-sensitive person; 2) reduce latex exposure in health care workers; and 3) improve our members' health and satisfaction.

The Exposure Control Plan was formally approved by senior management and physician leadership of the participating Divisions in late 1996; to facilitate implementation of the plan, a symposium on latex allergy for physicians was held in December 1996. Additional staff and patient educational materials have been produced and distributed within the Western Divisions.

Additionally, a comprehensive non-latex and powder-free latex glove evaluation and recommendation has been completed, and Purchasing and Materials Management staff have been educated to consider potential latex protein exposures when making product selections.

Latex Allergy Prevention and Exposure Control Guidelines

The Exposure Control Guidelines address the entire continuum of care, including inpatient, outpatient, and home health. Key points in the guidelines include 1) mechanisms to assure that patients in high-risk groups are provided a latex-safe environment as a part of their medical care and that all neonates are provided a latex-safe environment; 2) mechanisms to promote prevention of latex sensitivity by assuring that powder-free, low-allergen (as defined by FDA standards), and non-latex gloves are provided to reduce aeroallergen levels and to decrease the sensitization of HCWs and patients; 3) mechanisms to assure that patients in high-risk groups are identified and tested; 4) inclusion by health care providers of latex-related allergy questions in establishing, monitoring, and recording the patient's medical history; 5) recommendations for patient education; 6) strategies to assure that non-latex devices and latex-safe areas are available for patients and health care workers allergic to latex; 7) establishing policies that ban all latex products from Kaiser Permanente gift stores (ie, ornamental balloons).

"Individuals, such as health care workers, who have frequent exposure to latex proteins are more likely to become sensitized than average individuals in the population.[7]"

To facilitate implementation of the Latex Protein Allergy Prevention and Exposure Control Plan each medical center has convened a local "Latex Allergy Management Committee," modeled after the Interdivisional committee. In each area of the health care setting, the basic procedures of room selection and preparation, communication strategies, special precautions and considerations for external and internal product use, management of intravenous therapy and medication administration, management of emergencies, and educational needs are reviewed by the local committee and revised appropriately to minimize latex protein exposure. Substantial progress has been made in implementation of the Latex Exposure Control Plan within the participating Divisions, and completion is on target for the first quarter of 1998.

Although every area of the care environment may require modification to effectively manage latex allergy, special consideration should be given to Perioperative Services because of the potential for intraoperative anaphylaxis. In contrast to most allergic reactions evoked by intravenous drugs, which occur in 3 minutes, latex reactions usually occur 20 to 60 minutes after induction, when sufficient antigen has been absorbed transmucosally. Sometimes these reactions may not manifest with all the cardinal features of anaphylaxis and may be misdiagnosed as pulmonary embolisms, acute myocardial infarction, aspiration, or vasovagal reaction.[6] To assure proper diagnosis, a high index of suspicion regarding latex protein allergy must be maintained.

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Quality Improvement

Because of the potential workers' compensation and disability reimbursement costs and the organization's liability associated with latex allergy, establishing a quality improvement program that includes latex-related indicators is essential. Suggested indicators or areas for possible investigation include: workers compensation claims, union grievances, sick leave, malpractice claims, adverse anesthesia events, and unexplained anaphylaxis events. Additionally, monitoring of any adverse clinical events occurring despite the latex avoidance procedures in place of any error in latex avoidance and the selected glove program should be ongoing to identify any unforeseen problems (ie, contact dermatitis, decreased barrier protection, etc.).

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Conclusion

Kaiser Permanente strives to maintain an environment that is conducive to, high-quality patient care and to the health, safety, strategic development, and retention of a quality health care team. Latex has been identified as a potentially harmful, and sometimes lethal, antigen to allergic patients, employees, and physicians.

From our experience to date, through implementation of a comprehensive latex allergy prevention and exposure control plan and a quality improvement program that includes latex allergy-related indicators, improved patient care, and a reduction in incidence of latex-related incidents can be realized. ❖

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