Supporting Documentation On Latex Sensitivities

Allergic Occupational Disease Among Healthcare Workers: Latex Allergy and Beyond

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Allergic Occupational Disease Among Healthcare Workers: Latex Allergy and Beyond CME/CE

Disclosures

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Introduction

Asthma is a chronic inflammatory lung disease that affects approximately 17 million people in the United States.[1] The death rate from asthma had increased until 1988, plateaued by 1997, and has slightly declined since 1998. However, mortality rates for asthma among women have remained higher compared with men.[1,2] Surveillance data for work-related asthma have been helpful in assessing asthma prevalence and causative factors for the general population. Surveillance studies list healthcare workers as having a high incidence of occupational asthma due to exposure to cleaning products, latex, and poor indoor air quality.[3,4] In fact, the National Center for Health Statistics third National Health and Nutrition Examination Survey (NHANES) database found that the hospital industry was associated with the highest asthma prevalence among nonsmokers (14.4%).[3,4]

Widespread use of powdered latex gloves began in 1987 because of the institutional implementation of universal precautions to prevent transmission of infections.[5] Shortly thereafter, a myriad of adverse reactions among healthcare workers began to appear that were linked to natural rubber latex (NRL). Investigation of this occupational problem revealed that the most common reactions were either irritant-induced or secondary to allergic contact dermatitis to the NRL proteins.[5] Although a spectrum of allergic type I immunoglobulin (Ig)E-mediated reactions to NRL proteins has been identified, including contact urticaria and asthma, what brought this occupational problem to the attention of the general public was a series of anaphylaxis cases resulting in significant morbidity and, in some instances, death.[5] These fatalities most frequently occurred in high-risk patients, such as spina bifida patients, who had repeated contact with NRL proteins because of surgical and/or medical procedures.[5]

The institution of policies to use only low-protein, powder-free gloves has resulted in a dramatic reduction of visits to occupational health departments and of Workers Compensation claims due to occupational asthma. A retrospective investigation of health and economic outcomes in 67 healthcare workers with NRL allergy, confirmed by percutaneous reactivity to nonammoniated latex (NAL) extract, was conducted at our institution.[6] All 67 subjects experienced contact urticaria; 23 had rhinitis; and 25 had asthma symptoms, whereas 4 reported symptoms that were consistent with anaphylaxis.[6] Work-related symptoms, however, resolved in 44 of 49 (90%) of NAL skin-test-positive workers who had reported skin, respiratory, and/or systematic symptoms after switching to non-NRL gloves in their workplace.[6] Four workers with asthma symptoms had to change employment to an NRL-free workplace. However, this study indicated that avoidance of NRL results in favorable outcomes in most circumstances.[6]

A more recent study demonstrated that conversion to the use of powder-free, low-protein NRL gloves in the workplace not only reduced the NRL symptoms of healthcare workers but also positively affected the costs of glove purchases and Workers Compensation.[7] This 2-year longitudinal study conducted in 103 healthcare centers found that prior to converting over to powder-free gloves to reduce NRL-related symptoms and sensitization, 44% (36 of 82) of operating room personnel reported symptoms related to NRL exposure. Only 27% (22 of 82) of

these workers reported symptoms related to NRL exposure upon completion of this study. This intervention was associated with a significant cost savings of $10,000 per year for the purchase of gloves and with improved use satisfaction.[7]

Important questions in regard to latex allergy for the clinician are: (1) What is the best way to test a patient's suspected NRL allergy; (2) is it a good idea to do a latex challenge to correlate sensitization with symptoms, and, if so, what is the best way to do such a challenge; (3) what are the potential cross-reactivities with NRL; and (4) what are some of the associated problems that workers diagnosed with latex sensitivity experience? Each of these questions are addressed in the following sections.

Testing for NRL Sensitivity

Currently, there are no US Food and Drug Administration (FDA)-approved skin-test reagents for clinical use. NAL skin-test reagents are most commonly used for testing by clinicians to assess patients for NRL sensitization.[8,9] However, 13 proteins of NRL (*Hevea brasiliensis* [*Hev b*]) that bind human IgE have been isolated and characterized as *Hev b* allergens. Skin prick testing was performed with 7 native proteins purified from NAL; *Hev b* 1, 2, 3, 4, 6.01, and 7.01; and *Hev b* 13 in addition to the recombinant *Hev b* 5 protein in 62 healthcare workers with histories of NRL allergy previously confirmed to be latex-sensitized by percutaneous reactivity to NAL and in 49 atopic healthcare workers without NRL allergy.[8] Serum-specific IgE to these latex proteins was also performed for comparison with skin-test reactions. Over 60% of the NRL-sensitized subjects reacted to *Hev b* 2, *Hev b* 5, *Hev b* 6.01, and *Hev b* 13.[8] Reactions to *Hev b* 1, 3, 4, and 7.01 occurred in less than 50% of subjects. Only one of the control subjects reacted to a single *Hev b* antigen (*Hev b* 13). The 7 *Hev b* allergens tested yielded a specificity of 100% and *Hev b* 13 a specificity of 98% in confirming workers with NRL allergy.[8] However, specific IgE by AlaSTAT and CAP immunoassays correlated with skin-test reactivity in only 40 of 60 subjects (67%) and 33 of 62 subjects (53%), respectively, in NAL-reactive workers.[8] False-positive test results were identified in 4 of 49 (8%) NAL-sensitized subjects and 3 of 48 (6%) non-latex-sensitized control subjects.[8] Other investigators have found similar results. Kurup and colleagues[9] found that *Hev b* 2, 5, 6, and 13 together identified over 80% of healthcare workers with latex allergy, whereas *Hev b* 6 along with *Hev b* 1 or 3 detected specific IgE antibody in all sera studied from patients with spina bifida and latex allergy.[9] The in vitro *ImmunoCAP* with both *Hev b* 5 amplified and nonamplified correlated well with the clinical diagnosis of latex allergy in healthcare workers and in spina bifida.[9] They concluded that, although there is a heterogeneous specific IgE response to latex proteins among different patient groups, using certain combinations of purified recombinant antigens in commercial assays will detect latex-specific IgE antibody in the over 80% of latex allergic patients.[9] However, because these skin-test reagents are not currently available for clinical use, it is currently recommended that skin testing to a NAL skin-test reagent and a serum-specific IgE assay to latex protein be performed to assess whether a patient is sensitized to NRL.

Conducting a Latex Challenge

Depending on the patient's history and skin and serologic testing, latex challenge may be necessary to confirm a diagnosis. Quirce and coworkers[10] performed a "quantified environmental challenge" on 30 healthcare workers with possible occupational asthma with powdered NRL gloves in a 7-m^3 chamber; 28 of 30 were skin-prick-test-positive to an NRL extract.[10] Each subject would don and discard a pair of gloves every 3 minutes for up to 60 minutes. Airborne concentrations of NRL, ocular and respiratory symptoms, and pulmonary function were monitored.[10] They found that 26 subjects had rhinoconjunctivitis; 19 had an asthmatic response; and 1 developed eosinophilic bronchitis. The duration of exposure and concentration of NRL aeroallergen required an elicited response that varied significantly between subjects.[10] This method of donning and redonning gloves while monitoring for upper and lower respiratory symptoms and peak expiratory flow rates in a controlled office environment with emergency medical therapy readily available is an acceptable method for performing an NRL challenge in

order to confirm or exclude a diagnosis of latex allergy and/or asthma.

Prevalence and Risk Factors

A large Italian study designed to determine the prevalence and risk factors for latex hypersensitivity among healthcare workers revealed that the most common complaints were hand dermatitis and itching (86.3%), followed by urticaria (3.5%) and respiratory symptoms (2.9%).[11] Latex-specific IgE was found in 62 of 1747 healthcare workers (3.6%) and was 4 times more likely to occur in atopic individuals.[11] In this study, among healthcare workers with latex-related symptoms, 75 (44.6%) reported a personal history of atopy, and 24 (14.3%) reported oral allergy syndrome most commonly associated with kiwi, tomatoes, peaches, and melon/watermelon.[11] These potential reactions to specific foods (kiwi, chestnuts, avocados, and bananas) have been found to occur as a result of allergen cross-reactivity between class I chitinases found in these foods with the major latex allergen, hevein.[12]

The Strategy of Avoidance

Avoidance of powdered NRL gloves results in a decrease in sensitization and subsequent occupation-related problems.[13,14] One study[13] followed 88 healthcare workers with NRL and found that continued avoidance resulted in complete loss of sensitization to NRL in 24 subjects. One explanation for persistent sensitization to NRL in workers may be due to their continued exposure to NRL in the form of medical devices and home products.[15] Concentrations of latex-extractable proteins and *Hev b* 1, *Hev b* 5, and *Hev b* 6.02 antigens have been found to be high in a number of medical and nonmedical products.[15] Medical products implicated in NRL reactions include elastic bandages, tourniquets, Foley urinary catheter, Penrose drainage, and tape. Nonoccupational sources of NRL protein include rubber innersoles of shoes, balloons, latex mattresses, household or work rubber gloves, and inflatable mattresses.[15]

Work-related asthma and other associated occupational disorders (eg, dermatitis, urticaria, and rhinitis) have serious personal and economic consequences. In many cases, workers have been unable to avoid exposure to an inciting agent and cannot return to the workplace. Lost wages and healthcare costs, coupled with concerns about their health and the fear of not being able to return to work, can make patients with work-related health problems very challenging to manage. In most instances, complete avoidance of NRL protein is impossible, but reducing total latex allergen burden through the air or by direct contact is sufficient to prevent symptoms and allow those with allergies to function normally, and in many instances, remain in the workforce.[13,14] Therefore, it is important for the clinician to educate latex-sensitized workers about the benefits of practical NRL avoidance measures and to encourage the employer, whenever possible, to create a "latex-free" environment that would not only allow the employee to potentially return to the workplace, but also prevent new cases of NRL sensitization from occurring.

Cleaning Products

As mentioned previously, the most commonly reported exposures in addition to NRL in surveillance studies were cleaning products and poor air quality.[4] Workers most commonly reported exposure to products, such as disinfectants and cleaning agents. In fact, cleaning products have been associated with 12% of all cases of asthma across all industries and occupations.[4]

Cleaning agents are grouped into different categories on the basis of their use.[16] Disinfectants and surface-care products are considered the most hazardous groups and have been linked with asthma.[16] These agents often contain quaternary ammonium compounds (benzalkonium chloride, *n*-alkyl dimethyl benzyl ammonium chloride, and lauryl dimethyl benzyl ammonium chloride) that are used as surface disinfectants in clinical and food-preparation areas and a spectrum of volatile organic compounds.[4,16] Sensitization and the development of asthma to quaternary amines have been reported by our group in a woman who had had prolonged

exposure at her job to a cleaning solution containing benzalkonium chloride.[17] This case was confirmed by a single-blind, placebo-controlled, open-room study with the cleaning solution.[17] Subsequent cases have confirmed this finding in workers who were exposed to agents containing benzalkonium chloride.[18] However, cleaning agents also contain many other irritant chemicals, such as bleach, ammonia, hydrochloric acid, and volatile organic compounds that can cause or aggravate asthma. Controlled volatile organic compound exposure studies have found dose-related increases in lower respiratory symptoms, prompting recommendations to be made for indoor exposure levels to be regulated below 25 mg/m^3 to promote a "nonirritating" work or home environment.[19,20]

Domestic and Commercial Cleaning as a Risk Factor

A large multinational study designed to characterize workers exposed to high- and low-molecular-weight agents was conducted by questionnaire.[21] This study revealed that 304 workers out of the total population surveyed (n = 4492) were involved in domestic or commercial cleaning, and 84% were women. The prevalence of asthma and airway hyperresponsiveness was higher for cleaners, but of interest, the prevalence for atopy was lower compared with other groups of workers.[21] The latter observation was reported by other investigators studying the risk for asthma in cleaning workers.[22] Lung function was lower among cleaners with asthma than among office workers with asthma.[21] In this study, there was no difference in the risk for asthma between male and female, or smoking and nonsmoking cleaners.[21] This study was limited in that it could not assess exposures by exact type of occupation because it used a coding system that grouped certain occupations together (ie, cleaners included window cleaners, chimney sweeps, and road sweepers).[21] However, the investigators performed a more thorough follow-up questionnaire in 68 Spanish cleaners and found that 67 were indoor cleaners. Data concerning specific characteristics of the jobs and cleaning products used were not available for assessment.[21]

A subsequent cross-sectional survey conducted in 4521 women in regard to respiratory symptoms and their cleaning work history revealed that asthma was more prevalent in women who had ever been employed in domestic cleaning compared with women who never worked in cleaning.[22] Of interest, there was a higher asthma risk in former cleaners compared with current cleaners. This was attributed to the "healthy worker effect," or to differences in chemical exposures in current cleaners compared with ex-cleaners.[22] They estimated that 25% of asthma cases in their study population were attributed to domestic cleaning work.[22]

The results of these studies indicate that domestic cleaning exposures had an important public health impact that may also affect women in the general population who routinely clean their homes. Studies have previously estimated that 5% of the overall asthma risk for women may be secondary to household exposures and that household cleaning agents were one of the most common causes of non-work-related hospital admissions for asthma.[1,23,24] Investigation into the health impact of cleaning agents on women with and without asthma who regularly clean their homes is in progress.

Conclusions

In summary, occupational illness related to NRL exposure is a very serious health issue that has been significantly reduced through simple, cost-effective avoidance measures. Instituting a latex-free policy in healthcare facilities appears to have significant direct and indirect economic benefits that should not be ignored by the employer. However, it appears that a much broader initiative to improve overall indoor air quality in the workplace is required. This is based on the recent surveillance studies, which indicated that health-related problems, such as hives, asthma, rhinitis, and anaphylaxis, resulting from sensitization to NRL, have been surpassed by exposure to cleaning agents.

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