

THE DENTAL TEAM AND LATEX HYPERSENSITIVITY

ADA COUNCIL ON SCIENTIFIC AFFAIRS

For most of this century, natural rubber latex, or NRL—commonly known as latex—has been used for many applications in the health care setting. Such use has arisen essentially as a result of NRL's strength, elasticity, flexibility, tear resistance and barrier properties. During this time, complications arising from latex use have been thought primarily to be limited to irritant and allergic contact dermatitis, with only isolated reports of reactions consistent with a more serious immediate-type allergic reaction to NRL protein. In the late 1980s, however, there were notable increases in reports of serious reactions, particularly in association with barium enema procedures and medical procedures on children with spina bifida.¹⁻⁶ These reports raised awareness of the growing concern of NRL protein allergy in both patients and health care workers.

The first known case of NRL anaphylaxis in a dental professional was recorded in 1987 by Axelsson and colleagues.⁷ They described a dentist who, as a patient, had experienced anaphy-

ABSTRACT

Background. In the late 1980s, there were notable increases in reports of allergic reactions to natural rubber latex, or NRL, particularly in association with barium enema procedures and medical procedures performed on children with spina bifida. These reports also raised awareness of the growing concern about NRL allergy in both patients and health care workers.

Description of the Disorder. This report by the American Dental Association Council on Scientific Affairs summarizes the signs and symptoms of NRL protein allergy, allergic contact dermatitis and irritant dermatitis; offers information on means to diagnose these conditions definitively; and suggests means of reducing occupational exposure to the causative allergens and irritants in the dental office.

Clinical Implications. Reducing health care workers' occupational exposure may assist in minimizing adverse reactions associated with frequent wearing of gloves. The Council on Scientific Affairs will address issues relating to latex hypersensitivity among patients in a future report.

laxis during a routine gynecological examination. The reaction reportedly resulted from exposure to NRL protein in the physician's gloves. Since that first case, other reactions to a variety of NRL products have been reported involving dental professionals, dental patients and patients who were dental professionals.⁷⁻¹³

While the reason for the rising reports of immedi-

ate-type allergic reactions to NRL proteins remains unknown, several factors are believed to play some role:

- increasing use of NRL products as a result of infection control recommendations and regulations;
- distribution of some NRL products with higher latex protein content that results from insufficient leaching times during manufacture;
- the aerosolization of cornstarch powder, while donning or removing gloves, that may bind with the latex protein antigen and the consequent heightened exposure;
- a heightened cumulative exposure to latex proteins through direct contact and by aerosol inhalation;

TABLE 1

GLOVE-ASSOCIATED SKIN REACTIONS.

| ASPECT OF REACTION | IRRITATION | IN TYPE IV HYPERSENSITIVITY | IN TYPE I HYPERSENSITIVITY |
|--------------------------|--|--|--|
| Causative Agent | Toxic chemicals (such as biocides, detergents); excessive perspiration; insufficient rinsing or drying of hands; irritating chemicals used in glove manufacture | Chemical contact sensitizers used in glove manufacture: accelerators (such as thiurams, mercaptobenzothiazols, carbamates), antioxidants, preservatives; other chemical sensitizers used in dentistry (some of which can readily permeate gloves): biocides, detergents, acrylates, eugenol, local anesthetics | Latex proteins from <i>Hevea brasiliensis</i> (rubber tree) |
| Dermal Reactions | Acute: Red, scalded appearance; swelling; itching; excessive dryness Chronic: Dry thickened skin, crusting, deep painful cracking, scabbing sores, peeling | Acute: Red appearance, small blisters Chronic: Dry thickened skin, crusting, scabbing sores, vesicles, peeling | Acute: Hives, swelling, runny nose, nausea, abdominal cramps, dizziness, low blood pressure, bronchospasm, anaphylaxis Chronic: As above, increased potential for extensive, more severe reaction |
| Diagnosis | By exclusion of Type IV and Type I hypersensitivity | By skin patch test and consultation with a dermatologist | By skin-prick test, blood test and consultation with an allergist |
| Corrective Action | Allow condition to resolve; topical moisturizers and anti-inflammatory creams may help; review and refine protocols for hand-washing and for handling irritating chemicals; consider use of powder-free gloves; consider use of gloves that contain only small amounts of chemical additives | Allow condition to resolve; avoid sensitizing chemical; if sensitizing chemical is associated with glove manufacture, select an alternative glove (latex or a latex alternative) without the chemical | Use only nonlatex gloves and maintain a work environment in which latex levels are as low as reasonably achievable |

■ increased awareness and reporting.

NRL protein allergy, as well as other reactions associated with frequent glove use, can have potentially serious consequences for the dental worker. The dental team, therefore, should be knowledgeable about the signs, symptoms and diagnoses of these conditions and should consider means of reducing occupational exposure to the sensitizing or irritating agents (Table 1).

LOCAL AND SYSTEMIC REACTIONS ASSOCIATED WITH GLOVE USE

NRL protein allergy: immediate, or Type I, hypersensitivity. Immediate, or Type I, hypersensitivity to NRL protein describes the antibody-mediated allergy that has been increasingly documented over the last 10 years. The primary source of exposure to NRL protein in the dental office is NRL gloves, which are used routinely in the provision of dental treat-

ment. Type I hypersensitivity is an immunological reaction directed against latex protein components; such proteins can be on the surface of NRL gloves, can migrate to the surface of latex gloves when moistened, or can attach to the cornstarch donning agent¹⁴⁻¹⁷—which can carry additional NRL protein to the skin. Furthermore, NRL protein-powder particles from powdered NRL gloves can become airborne when gloves are donned and removed, resulting

in additional respiratory and conjunctival exposure.

A Type I reaction can occur as soon as two to three minutes, or as long as several hours, after skin or mucous membrane contact with the protein allergens.^{18,19} Symptoms include skin redness, hives or itching at the contact site. More severe reactions, however, can induce respiratory symptoms such as a runny nose, sneezing, itchy eyes, a scratchy throat and asthma. In rare cases, anaphylaxis occurs. Anaphylaxis is a clinical syndrome involving multiple organ systems including the skin, the respiratory tract, the cardiovascular system and the gastrointestinal system. If left untreated, anaphylaxis can lead to death as a result of severe hypotension, swelling in the area of the larynx and/or bronchospasm.

Allergic contact dermatitis: delayed, or Type IV, hypersensitivity. Allergic contact dermatitis arises as a result of an immunological reaction to chemicals added to both latex and synthetic gloves during the manufacturing process.²⁰⁻²² The most frequent chemical offenders are accelerators, which are used during production to catalyze the cross-linking of elastomeric particles. These chemicals include—in decreasing order of their implication as contact sensitizers—thiurams; mercaptobenzothiazols, or MBTs; and carbamates.²³

These chemicals, among others, can cause skin reactions (dry, cracked, pruritic skin) that appear four to 96 hours after exposure. In the reaction's most acute form, vesicles or blisters appear. Symptoms can extend up the arm beyond the bound-

ary of glove contact. If subsequent exposure to the allergen is avoided, the condition usually resolves within four days, but it can become a chronic and more serious problem if the condition is not allowed to resolve. With chronic exposure, the initial symptoms of pruritus, erythema and blisters or vesicles progress to lichenification (callus formation) of the skin; deep, painful cracking and intermittent bleeding result. Such symptoms can require months to completely resolve.

Irritant dermatitis. A condition often confused with the two allergic conditions described above, irritant dermatitis is very common among frequent users of both latex and synthetic gloves.^{21,22} Characterized by dry, itchy, irritated areas of the skin confined to the area of glove contact, irritant dermatitis is not a result of an immunological reaction but rather of skin irritation—usually as a consequence of exposure to chemicals used in the workplace (for example, soaps, detergents and disinfectants) and insufficient rinsing and/or drying of the hands. Irritation, however, also could be a result of the use of certain chemicals (such as biocides and fragrances) during the gloves' manufacture. Symptoms of irritant dermatitis can be further exacerbated by the cornstarch powder found in many brands of gloves.

PREVALENCE

The exact prevalence of Type I hypersensitivity to NRL protein among health care workers is unknown, and reports vary widely. This disparity arises primarily as a result of the heavy reliance on self-reported

histories of hand dermatitis, rather than definitive diagnosis of NRL protein allergy through use of the skin-prick test, or SPT. Recent studies estimate the prevalence of NRL protein allergy in health care workers to range from approximately 4 percent to 10 percent^{12,13,24-34}; reports for the general population range from 0.12 percent to 6 percent.^{35,36} In specific relation to the dental profession, skin-prick testing of dentists, hygienists and assistants at the ADA Health Foundation's Health Screening Program in 1994 and 1995 revealed that the estimated average prevalence of NRL protein hypersensitivity among dental professionals was 6.2 percent.³⁷ Another study of dental workers found that of the 19.2 percent subjects self-reporting having a positive history of hand dermatitis, only 3.8 percent actually had NRL protein allergy.³⁴

With regard to allergic contact dermatitis and irritant dermatitis, a study found that of 1,301 hospital employees, 21 percent suffered from occupationally based hand dermatitis; however, 95 percent of these cases were cases of irritant dermatitis, rather than allergic contact dermatitis, as determined by skin-patch testing.³⁸ This and other studies suggest that among health care workers, irritant dermatitis—rather than NRL protein allergy and allergic contact dermatitis—is likely the most common skin condition associated with frequent glove use.

DIAGNOSING SKIN CONDITIONS ASSOCIATED WITH FREQUENT GLOVE USE

Localized skin reactions associ-

ated with NRL protein allergy, allergic contact dermatitis and irritant dermatitis can manifest themselves with similar symptoms (pruritus, cracking, burning, reddening and soreness of the skin). As a result, health care workers experiencing skin reactions to NRL gloves often automatically assume that they are allergic to latex. This assumption clearly is unwarranted. Therefore, to ensure that appropriate corrective measures are instituted, it is of vital importance that the skin condition be definitively diagnosed.

Diagnosing NRL protein hypersensitivity. A first step in establishing the possibility of an NRL protein allergy is obtaining a medical history. Pertinent risk factors, signs and symptoms include the following:

- repeated surgical procedures;
- occupational exposure to latex (such as for certain health care workers);
- membership in a high-risk group (such as people with atopy; spina bifida; or genitourinary abnormalities or other disorders that require repeated urinary catheterization and surgery at a young age);
- swelling, itching and redness resulting from contact with items containing natural rubber latex (such as balloons, latex gloves, rubber dams, prophylaxis cups, orthodontic elastics, condoms, diaphragms, adhesives);
- symptoms (such as nasal congestion, sneezing, itching, conjunctivitis, wheezing, chest tightness, urticaria, facial swelling or flushing) resulting from exposure to airborne latex proteins;
- unexplained anaphylaxis during surgery or medical or dental procedures;

- allergic reactions to bananas, kiwis, avocados, chestnuts and other foods with immunological cross-reactivity with NRL proteins;
- increase in frequency or severity of asthmatic attacks or acute onset of asthma in a person with no asthmatic history;
- noticeable worsening of seasonal allergies.

Used by dermatologists and allergists throughout the world, the SPT is the most sensitive and specific in vivo approach to diagnosing a suspected NRL protein allergy. The SPT also allows an evaluation of the degree of skin sensitivity to the allergen and of the likelihood of an allergic episode on exposure. In vitro blood tests—radioallergosorbent tests, or RASTs—approved by the U.S. Food and Drug Administration also are available commercially (ImmunoCAP, Upjohn-Pharmacia; AlaSTAT, Diagnostic Products Corp.). However, while such tests are probably more convenient than the SPT, they are considered less reliable. Specificities of the RAST range from 80 percent to 87 percent, and sensitivities from 50 percent to 90 percent.³⁹ A negative RAST result does not exclude NRL allergy. A negative blood test in people demonstrating a strong medical history of NRL protein allergy would simply indicate the need for a follow-up SPT.

Skin-prick testing should be conducted only by a qualified allergist or dermatologist.

Diagnosing allergic contact and irritant dermatitis. Allergic contact and irritant dermatitis can be caused by one or a combination of the many chemicals used in health care. Skin patch testing is the only

method available for adequately diagnosing contact dermatitis and identifying the specific chemical(s) responsible for a skin eruption. Irritant dermatitis can be diagnosed by exclusion when all the appropriate skin patch tests give negative results.

As certain chemicals used in the dental office (such as glutaraldehydes and acrylates) readily permeate most examination glove materials, allergic contact and/or irritant dermatitis resulting from exposure to these chemicals often is attributed mistakenly to the glove rather than to the true allergen or irritant. Therefore, patch testing with an array of chemical allergens common to the health care environment—including, but not limited to, rubber-processing chemicals—should alleviate confusion over the sensitizing chemical(s).

Skin patch testing should be conducted only by a qualified allergist or dermatologist.

AVOIDANCE MEASURES

NRL protein hypersensitivity. A diagnosis of an NRL protein allergy could have serious consequences for the dental worker as continued exposure to even minute amounts of the protein could trigger an allergic reaction. Generally, the way to avoid an allergic reaction is to avoid—to the extent feasible—contact with the allergen. This is difficult in the case of NRL, since latex is used in a wide variety of common dental and nondental products. In addition to gloves, NRL may be found in dental dams, bite blocks and prophylaxis cups. It may also be found in elastic on underwear, leg and waist clothing, carpet backing, erasers, rubber bands,

TABLE 2

| GLOVE MATERIALS AND USES. | | | | | | |
|---------------------------|-----------------------------|---|--|---|--|--------------------|
| MATERIAL | COMPOSITION | SOURCE | ADVANTAGES | DISADVANTAGES | USE | COST |
| Natural rubber latex | cis 1,4 polyisoprene | <i>Hevea brasiliensis</i> (rubber) tree | Fit; feel; elasticity; memory; resistance to acids, alkalis, salts, ketones; variety of styles | Aging compromises elasticity and barrier protection; contains allergenic proteins and sensitizing chemicals; soluble to some solvents | Surgical and non-surgical procedures | Low/moderate |
| Vinyl | Polyvinylchloride | Synthetic | No protein allergens; resists acids, alkalis, fats and alcohols; resists aging | Moderate flexibility; limited fit and feel; fatigues quickly; contains irritating chemicals | Short-duration nonsurgical procedures; laboratory procedures | Low/moderate |
| Nitrile | Acrylonitrile and butadiene | Synthetic | Resists cuts, abrasions and punctures; resists solvents better than latex or neoprene | Limited fit, feel and flexibility; contains sensitizing chemicals [†] | Decontamination; non-surgical procedures; utility; laboratory procedures | Moderate/expensive |
| Neoprene | Chloroprene | Synthetic | Resists chlorinated solvents, alcohol, alkalis, oils and petroleum | Reduced elasticity, limited fit, feel and flexibility; contains sensitizing chemicals [†] | Surgical and non-surgical procedures; laboratory procedures; decontamination | Moderate/expensive |
| Plastic | Polyethylene | Synthetic | Lightweight | Limited fit and feel; limited strength | Overgloves or undergloves; food service | Low |
| Tactylon (Safeskin Corp.) | Styrene-based copolymers | Synthetic | Tactility; elasticity; resists oxidation; no proteins or sensitizing chemicals | Soluble to some solvents; transparent look not universally accepted | Surgical and nonsurgical procedures; laboratory procedures | Moderate/expensive |

* Adapted from OSAP Monthly Focus.⁴⁰
[†] Some glove brands contain lower concentrations of allergenic proteins and/or sensitizing chemicals than others. The ADA Council on Scientific Affairs recently adopted guidelines that establish maximal protein levels in natural rubber latex gloves and criteria for gloves claiming to be powder-free.

rubber shoe soles and insulation material, to give just a few examples.

However, there are some simple steps that dentists may take to reduce exposure to the primary sources of NRL in the dental office. These should be

sufficient to protect all but the most sensitive workers, but dentists should always base their decisions about what is needed to protect an individual worker with a latex allergy on discussions with the worker and his or her physician.

The following recommendations are based on those issued by the National Institute of Occupational Health and Safety in June 1997.³⁶ They are intended to provide general guidance for avoiding exposure to NRL. They are not a substitute for a

particularized decision about the appropriate avoidance measures to take in the case of an individual dental worker.

Dental workers who are definitively diagnosed with NRL protein hypersensitivity should avoid, as far as feasible, subsequent exposure to the protein and should only use nonlatex (synthetic) gloves; remaining staff members in the dental practice should wear either a synthetic or a powder-free latex glove (Table 2). (The Organization for Safety and Asepsis Procedures⁴⁰ has provided a list of such gloves.) Additionally, only synthetic or powder-free latex rubber dams should be used. Dry rubber products commonly used in dental practice (for example, bite blocks, prophylaxis cups) probably do not need to be replaced (unless the NRL protein-allergic dental worker is receiving dental care).

In addition to the use of synthetic or powder-free latex gloves, dental personnel can further reduce occupational exposure to NRL protein by taking the following steps:

- using low-protein, powder-free latex gloves;
- frequently changing ventilation filters and vacuum bags used in latex-contaminated areas;
- checking ventilation systems to ensure they provide adequate fresh or recirculating air;
- frequently cleaning all work areas contaminated with latex dust;
- educating the dental staff on the signs and symptoms of latex allergies.

NRL protein sensitization. Although a recent study of dental school students suggests that the longer they are in

school, the more frequently their SPT results are positive for NRL protein allergy,⁴¹ the actual degree of NRL protein exposure needed to produce sensitization is unknown. Indeed, sensitization likely will depend on a number of factors, including not only the route, dose and frequency of exposure but also the person's genetic susceptibility. However, studies of other allergy-causing substances pro-

The actual degree of natural rubber latex protein exposure needed to produce sensitization is unknown.

vide evidence that, in general, the higher the overall exposure to a particular antigen in a population, the greater the likelihood that more people will become sensitized.⁴²

Despite the fact that no dose-response relationship has been established between exposure to latex proteins and sensitization, dentists may choose to use one or more of the avoidance measures described above for precautionary reasons. Such decisions will require the dentist to weigh the theoretical advantage of reduced exposure to NRL against the utility of NRL products and the availability of suitable alternatives. The FDA has cautioned that the use of powder-free gloves may affect other glove properties, such as barrier efficacy and shelf life.⁴³

Contact and irritant dermatitis. Studies suggest that most sensitizing NRL proteins do not pass through intact skin.⁴⁴ This finding is consistent

with speculation that disruption of the skin barrier, through either allergic contact or irritant dermatitis, can facilitate the passage of sensitizing NRL proteins into the body, thus potentiating the risk of development of NRL protein allergy.⁴⁵⁻⁴⁷ On this basis, diagnoses of irritant or allergic contact dermatitis should not be taken lightly, and corrective measures to resolve either condition are recommended.

Should allergic contact or irritant dermatitis be diagnosed, subsequent exposure to the specific chemical(s) should be avoided to the extent feasible. Hand care in the form of topical moisturizers, corticosteroids and periods of glove avoidance also may be helpful in resolving the symptoms. (Note: Any moisturizers used should be latex-compatible, nonoil-based and formulated not to compromise glove integrity.) In relation to contact dermatitis that results from chemical additives used specifically in the glove manufacturing process, further exposure can be avoided by using a frequently washed/changed glove liner, changing to a different brand of NRL glove or using a synthetic glove that does not contain the sensitizing chemical. Random switching between different NRL glove brands in attempts to avoid a specific chemical is not advised. Clinicians should consult with glove manufacturers before selecting a different NRL glove to ensure the chemical allergen is absent.

It also should be noted that vulcanization accelerators (for example, thiurams, MBTs and carbamates), as well as some of the antioxidants used in the manufacture of NRL gloves,

also are used in the manufacture of some synthetic gloves, such as those made of nitrile and neoprene. Therefore, the selection of a nonlatex glove does not necessarily ensure avoidance of the sensitizing chemical. Again, consultation with the glove manufacturer is advised before selection of a synthetic glove.

THE ADA ACCEPTANCE PROGRAM AND GLOVE SPECIFICATIONS

The ADA Council on Scientific Affairs is aware that Type I NRL allergy is a significant problem for some dental care providers and acknowledges that the use of synthetic gloves, as well as low-protein/powder-free latex gloves, can reduce the risk of sensitization or allergic reaction. With this in mind, the Council on Scientific Affairs recently revised its Acceptance Program Guidelines for Infection Control Products to address powder content and protein levels in latex gloves, and also is developing guidelines for the acceptance of synthetic gloves. (The ADA Acceptance Program is a voluntary program that evaluates the safety and efficacy of dental products and awards the Seal of Acceptance to products that meet ADA guidelines. The ADA reviews all promotional claims made for accepted products to ensure that they are truthful and not misleading.)

The revised guidelines will require latex gloves that are submitted to the ADA's Seal of Acceptance Program and claiming to be "powder-free" to contain no more than 0.7 milligram of particulate per gram of glove when tested according to standard D6124 of the American

Society for Testing and Materials, or ASTM.⁴⁸ The same guidelines also will set the maximum protein content of ADA-accepted latex gloves at no more than 200 micrograms per gram when tested according to ASTM standard D5712-95.⁴⁹ The Council currently is discussing the implementation of these new guidelines with industry. Members will be informed through ADA publications when latex gloves conforming to these new guidelines are available through the Acceptance Program. Similar standards also are currently being considered by the FDA and the American National Standards Institute, or ANSI, Accredited Standards Committee MD156, which is sponsored by the ADA.

The FDA has reported that some manufacturing processes for producing powder-free gloves also lower the total amount of protein allergen on the finished product.⁴² Therefore, on the basis of preliminary observations, the use of powder-free gloves appears to reduce both the level of airborne allergen and the amount of allergen remaining in the finished product. However, as stated earlier, dentists should be aware that technologies for the production of powder-free gloves can affect other glove properties, such as barrier efficacy and shelf life.⁴²

When selecting NRL gloves with "powder-free" or "maximum-protein" claims, dental personnel should look for the ADA Seal of Acceptance or otherwise ensure that the gloves meet both the ADA definitions of "maximum protein" and "powder-free," as well as all specifications as outlined in the ANSI/ADA Specification 76 for Non-Sterile Natural Rubber

Latex Gloves for Dentistry⁵⁰ (such as tensile strength and ultimate elongation, before and after accelerated aging). Further, as noted above, the actual degree of NRL protein exposure needed to produce sensitization or allergic reaction (in already-sensitized people) is unknown, and the dental team should be aware that while the appropriate use of powder-free gloves and gloves with reduced protein levels can reduce the risk of sensitization or allergic reaction, it will not eliminate it.

CONCLUSION

In summary, NRL protein allergy, as well as other reactions associated with frequent wearing of gloves, can have potentially serious consequences for the dental worker. The dental team, therefore, should be knowledgeable about the signs, symptoms and diagnoses of these conditions and should consider means of reducing occupational exposure to the sensitizing or irritating agents.

Latex hypersensitivity is an area of emerging science. The information contained in this report is based on currently available data. The ADA Council on Scientific Affairs will continue to inform the profession as new information becomes available. ■

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