Atatürk Üniv.Diş Hek.Fak.Derg.
(Cilt:13, Sayı:3, Cilt:14, Sayı 1), Sayfa:29-38, 2003-2004

INVISIBLE DANGER IN DENTISTRY: LATEX

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DİŞHEKİMLİĞİNDE GÖRÜNMEYEN TEHLİKE: LATEKS

ÖZET

Ellerin fiziksel, kimyasal ve biyolojik kontaminasyonuna karşı fiziksel bir bariyer olarak eldivenlerin kullanımı, sağlık alanında çalışanlar tarafından yaygın olarak kabul görmüştür. Diş hekimleri ve diş hekimliği öğrencileri tarafından hasta tedavisinde rutin olarak kullanılan eldivenlerde, lateks yaygın bir şekilde eldiven materyali olarak kullanılmaya başlanmıştır. İnhalasyon ve deri aracılığı ile absorbsiyonu en yaygın etkilenme yolları olan ve bazı bireylerde IgE cevabı şeklinde ortaya çıkan lateks proteinleri güçlü allerjenler olarak görülmektedir. Bu makalenin amacı, latekse (Natural Rubber Latex) karşı aşırı duyarlılık reaksiyonunun patogenezi, lateks eldivenlere karşı oluşan reaksiyon tipleri, latekse karşı aşırı duyarlılık reaksiyonlarının epidemiyolojisi ve etyolojisini derlemek, lateks alerjisi olan hastaların teşhis ve tedavi prosedürlerini ortaya koymak ve lateks alerjisi olan sağlık çalışanlarında genel önlem stratejilerini tartışmaktır.

Anahtar Kelimeler: Doğal Lastik Lateks, Eldiven, Diş Hekimliği, Mesleki Allerjik Reaksiyonlar, Teşhis, Tedavi

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SUMMARY

The use of gloves as a physical barrier against physical, chemical or biological contamination of the hands has achieved universal acceptance by health care workers. Gloves are now worn routinely by most general dental practitioners and dental students while treating patients, with latex being the most commonly used glove material. Latex proteins have been shown to be potent allergens, which elicit an IgE response in certain individuals; the most common routes of exposure include inhalation and absorption through the skin. The purposes of this article are to review the latex manufacturing process, pathogenesis of hypersensitivity reactions to latex, spectrum of reactions to latex gloves, epidemiology and aetiology of hypersensitivity reactions to latex, to suggest diagnosis and treatment protocols for the management of patients with latex allergy, and to discuss Universal Precaution strategies to accommodate the latex-allergic health care worker.

Key words: Natural Rubber Latex, Gloves, Dentistry, Occupational Allergic Reactions, Diagnosis, Treatment

INTRODUCTION

The concept of universal precautions was first suggested as being the standard by which dental practitioners operated in respect of infection control in 1987. This involved the adoption of two major assumptions: that all patients must be considered as potentially infectious and should be treated using similar personal protective barriers; and that the barriers are capable of preventing occupational acquisition of disease.[1]

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Among the measures suggested as being necessary were the use of gloves, masks, protective eyewear and gowns to practitioners from contact with patient body fluids, especially blood and saliva.[1]

Dentists and their patients have been shown to be at risk for transmission of blood-borne diseases,[2] and the Centers for Disease Control and the American Dental Association have recommended glove use during all dental procedures.[3]

The use of latex gloves as a physical barrier against physical, chemical or biological contamination of the hands has achieved universal acceptance by health care workers. Since the potential risk of contracting hepatitis B or hepatitis C virus, human immunodeficiency virus (HIV) and other blood-borne pathogens from various body fluids has become more apparent over the past decade, dental professionals have come to rely heavily on latex gloves as a means of protecting themselves and their patients.[4]

William Halstead[5] introduced surgical gloves made of latex rubber in 1890. Almost 100 years passed before Nutter[6] reported the first case of latex allergy in 1979. Since that time, latex allergy has become an emerging and serious phenomenon that has implications not just for health care workers but also for all of society.

Coincidentally, the increased use of latex gloves has increased the demand for manufacturers to produce and supply latex gloves. This increased demand for latex gloves may have temporarily altered manufacturing procedures, which in turn may have resulted in a poor-quality, highly allergenic product.[5,7] Although the manufacturers have been blamed for the reported increase in latex allergy, the reason for the increase remains unclear.[8]

The purposes of this article are to review the latex manufacturing process, pathogenesis of hypersensitivity reactions to latex, spectrum of reactions to latex gloves, epidemiology and aetiology of hypersensitivity reactions to latex, to suggest diagnosis and treatment protocols for the management of patients with latex allergy, and to discuss Universal Precaution Strategies to accommodate the latex-allergic health care worker.

NATURAL RUBBER LATEX

Natural Rubber Latex (NRL) is widely used in manufacturing of medical devices (gloves, catheters, draining tubes, anesthetic masks, dental dams), as well as in a variety of everyday articles (household gloves, toys, balloons, condoms, baby pacifiers, sports equipment, tyres, adhesives).

In the chemical industryís nomenclature, the term latex applies to any emulsion of polymers, including synthetic rubbers and plastics. NRL refers specifically to products derived from the milky fluid, or latex, produced by the laticiferous cells of the tropical rubber tree Hevea braziliensis (family of Euphorbiaceae).[9] NRL consists of three main components: rubber particles and lutoid dispersed in an aqueous serum (cytosol). Rubber particles are spherical droplets containing polymers of cis-1,4 polyisoprene (Figure.1) coated with a layer of hydrophilic colloid (proteins, lipids and phospholipids). Lutoids are vacuoles with a low internal pH that are involved in the coagulation of latex though the release of proteins interacting with rubber particles. Fresh NRL consists of about 30-40% rubber hydrocarbon and 2-3%

proteins.[10] Hevein (5kDa) and hevein preprotein (or prohevein, 20kDa) are major proteins of the lutoid bodies. Hevein has chitin-binding properties and inhibits the growth of chitin-containing fungi.[11] Hevamine (29kDa), an enzyme with lysozyme/chitinase activity, has also been isolated from the lutoids. [12]

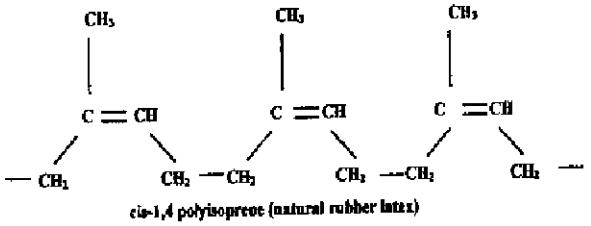

Figure 1. Chemical structure of natural rubber latex (cis,1,4 polyisoprene) (Vandenplas (1995))

Latex rubber can be found both in the home and in the workplace. It is estimated that over 40000 products contain latex rubber. It would be impossible to compile a list of all latex-containing products. Table I lists some of the more commonly used home products that may contain latex.[5]

Table I. Common householdproducts that may contain latex (Spina and Levine, 1999)

- Rubber toys	- Condoms
- Athletic shoes	- Racquet handles
- Swimming, snorkeling, and scuba equipment	- Rubber bands
	- Carpet backing
- Erasers	- Tires
- Elastic fiber diapers	- Rubber mats
- Elastic bands on clothing	- Household gloves
- Halloween mask	- Infant pacifiers and feeding nipples
- Adhesives	
- Balloons	

The list of patient care products that contain latex enormous. This list is in a constant state of evolution, and before any product is used on a latex-allergic patient, the manufacturer should be contacted to verify the latex content of the product. Table II lists some of the more frequently used products in patient care that may contain latex.[5]

Table II. Patient care supplies that may contain latex (Field and Fay (1995), Spina and Levine (1999)).

General Patient Care Supplies:	*Dental Supplies:*
- Latex gloves	- Rubber dam
- Patient identification band	- Prohy cup
- Blood pressure cuff and tubing	- Orthodontic elastic
	- Bite blocks
- Urinary catheters	- Nitrous oxide masks
- Nasogastiric tubes	- Rubber stoppers on local anesthetic carpules
- Chux	
- Reflex hammer	- Penrose surgical drains
- Surgical masks, hats, shoe covers, and gowns	- Face mask with elastic ties
	- Suction tubes
- Surgical drapes	- GA props
- Tape	- Teeth protectors
- Temperature probes	- Fingercot
- Electrode pads	
- Axillary and hand pads for crutches	

PATHOGENESIS OF HYPERSENSITIVITY REACTIONS TO LATEX

Allergies are non-protective, damaging form of immune response in which the body reacts to organism, toxins, or foreign bodies. With allergens, the body triggers an immune response that is abnormal and often injurious to tissues.[13] The degree of immune response is affected by genetic predisposition, environmental factors, the allergen itself, the route of

sensitization, length and frequency of exposure, a personal history of atopy, and any pre-existing local or systemic condition in the affected individual. Latex proteins have been shown to be potent allergens, which elicit an IgE response in certain individuals; the most common routes of exposure include inhalation and absorption through the skin.[14-16]

Latex exposure can occur through various routes, including the skin, mucous membranes, respiratory system, and vascular system. Cutaneous exposure occurs when any product with latex contacts the skin. Although exposure can occur with intact healthy skin, certain conditions can increase the susceptibility of the skin to latex allergens. When the protective barrier of the skin is weakened by contact dermatitis, latex proteins may be more easily absorbed via the cutaneous route.[5]

Mucous membrane contact with latex proteins has resulted in a number of severe reactions. Most of the reports involve the mucous membranes of the mouth, vagina, urethra, and rectum.[17] The respiratory route of exposure occurs mainly from aerosolized powder or from anesthesia circuits.[18] The cornstarch powder used to ease the donning of surgical gloves absorbs many of the latex allergens. It is this powder-protein complex that sensitizes patients, not to cornstarch powder itself. The powder-protein complex becomes aerosolized every time gloves are donned and removed, and aerosolization also occurs as a result of resuspension from reservoirs in the room and on clothing.[19]

The first well documented case asthma induced by NRL gloves was reported in 1988 by Seaton et al.[20] who postulated that the offending agent was terpene vapour. There is now convincing evidence both from in vitro and in vivo experiments that NRL proteins can bind to cornstarch glove powder,[21] and function as airborne allergens inducing respiratory reactions through an IgE-metiated mechanism.[22-24]

SPECTRUM OF REACTIONS TO LATEX GLOVES

The dental community have become concerned with three types of reactions, which appear to be associated with latex gloves: non-allergenic or irritant reactions, delayed or Type IV hypersensitivity reactions, and immediate, (Type I) IgE mediated responses.

Irritant Reactions:

Latex gloves may cause an irritant contact dermatitis (ICD), which is a direct injury, much like an abrasion or burn that affects the superficial layers of the skin. Irritant dermatitis is not an allergic reaction and usually occurs a result of contact with chemicals, such as acids, alkalis or glove additives. The condition is aggravated by frequent hand washing and exposure to disinfectants or detergents. It is also exacerbated by excessive sweating while wearing protective gloves,[25] and by poor hand hygiene. Glove powders may also play a part in the development of an ICD and Grand et al.[26] reported that an inflammatory response can be evoked by glove starch powder. However the results of a recent survey concerning the incidence of dentistsí perceived skin irritation showed that this was unrelated to the presence of glove powders.[27]

Early manifestations of an irritant reaction appear as ëchappingí ie itchy, dry skin, particularly on the finger webs or under the ring.

Greater degrees of irritation result in burning, red or swollen tissue and cracking or flaking of the skin. Vesicles (blistering) are a late manifestation of irritant contact dermatitis but are unlikely to occur in ICD due to rubber gloves.[28]

Delayed Reactions:

Delayed cutaneous reactions (Type IV) to natural rubber latex appear to be the result of chronic exposure to chemical, mainly of the thiuram groups (eg tetramethyl thiuram disulphide and zinc mercaptobenzothiazole), which are used as accelerators in the vulcanization process.[28]

Immediate Hypersensitivity Reactions:

Latex allergy is defined as the demonstration of IgE mediated sensitivity to latex proteins. There is a wide spectrum of IgE mediated responses to latex, which range from contact urticaria to anaphylactoid reactions.[4]

Signs and symptoms of a Type I reaction include intense itching, swelling, wheals on the skin, conjunctivitis, rhinitis and asthma. In some cases these reactions can lead to low blood pressure, cardiac arrhythmia, difficulty with breathing and death.[14,29]

Most recorded Type I latex IgE mediated reactions have occurred in persons who frequently use latex products. Atopic individuals with hand eczema appear to be particularly vulnerable to developing contact urticaria but concern has also been expressed about the progression of a Type I latex protein allergy in several reported individuals.[30]

EPIDEMIOLOGY OF LATEX REACTIONS

Over the last few years, a number of scientific papers have reported cases of latex-associated dermatitis, contact urticaria syndrome, respiratory symptoms and anaphylaxis on exposure to various natural rubber products. Suspected latex reactions, appearing in various international medical journals, have included both patients and healthcare workers.[21,31]

Unfortunately, increased glove usage parallels reports of adverse reactions among health-care practitioners.[4] The prevalence of latex allergy in the general population is not accurately documented, but it is believed to be very low.[5] The prevalence of latex allergy among physicians is reported at 9.9% in North America[32] and 7.4% in Finland16. Members of the dental profession are also high risk for developing latex allergy. In a survey of US Army dentists[3], 13.7% reported symptoms related to the use of latex gloves. Recently reported rates of natural rubber latex sensitization in the general public range from as low as 0%33 up to 9.4%34. In dental personals, this range from 13.7%3. To date, 16 fatalities secondary to latex anaphylaxis have been reported, none of which was secondary to dental treatment.[35] There is a lack in the literature about the determinate of the latex allergy for dentists and dental students. However, in a study, which was performed in Gulhane Military Medical Academy personals, has been reported.[36]

AETIOLOGY OF HYPERSENSITIVITY REACTIONS TO LATEX

While factors underlying increased reports of IgE mediated hypersensitivity have yet to be quantified, many researchers suspect the following factors have played a significant role in occupationally acquired sensitization to latex: 1. glove manufacturing changes that have resulted in higher levels of residual chemicals and/or latex proteins on some gloves; 2. implementation of

universal precautions which has led to increased frequency and wear time of gloves, and 3. hand dermatitis stemming from frequent hand washing with antimicrobial agents and poor hand care habits. While threshold levels for various allergens have yet to be established, most researchers agree that chemicals used in glove manufacture, latex proteins and cornstarch lubricating powders (which serve as vectors for proteins) are the culprits involved in worker sensitization.[37,38]

RISK FACTORS

Although the risk for latex allergy in the general population is quite low, certain populations are considered at higher jeopardy than others for latex allergy. Anyone with a history of multiple latex exposures, a personal or family history of atopy, or one or more of certain food allergies falls into this higher risk group. Multiple latex exposures are more commonly found in patients with spina bifida and multiple-surgery patients as well as in health care and latex industry worker[5]. (Table III)

Table III. Groups at hig risk of developing latex allergy (Field and fay (1995)).

- Spina bifida patients
- Patients with urogenital anomalies
- Dentists, dental hygienists and other health care professionals
- Atopic patien\ts
- Latex industry workers
- Patients who have undergone multiple surgical procedures

Health care providers, including members of the dental profession, are regularly exposed to a variety of latex products. The Occupational Safety and Health Administration estimates that more than 5 million American health care workers use latex gloves, with over 7 billion pairs of latex gloves used annually in the United States5. The frequent exposure of health care workers to latex products is responsible for the increased risk of latex sensitization in this population group.[39]

DIAGNOSIS

The difficulty in diagnosing an allergic reaction lies in the fact that the symptoms of latex sensitivity are widely variable among different individuals. While the tendency to develop some type of allergy in atopic individuals is an inherited trait, the specific form of allergic response varies according to an individualís genetic make-up, the mode of exposure and the amount of bioavailable antigen.[40,41] Diagnosis, therefore, depends upon careful history taking, analysis of symptoms and allergy testing as well as careful screening of products involved to ensure accurate diagnosis.[24,42]

Case History

Any of the following complaints and symptoms, which usually appear within the first 30 min of exposure to a NRL product, should be noted contact urticaria, rhinitis, coughing, wheezing, chest tightness, hypotension, and dizziness or collapse.[43]

In addition, symptoms induced by handling or contact with other NRL-containing items (Table I).

Any familial and personal atopic predisposition is an indicator for the risk of latex sensitization and may result in problems recognizing allergic occupational disease. Because of the above-mentioned immunological cross-reactivity between NRL allergens and various food allergens, the survey should also include any symptoms (swollen tongue or lips, abdominal pain, diarrhea, urticaria, rhinitis, asthma) during or after consumption of any of the following foods: avocado, chestnut, banana, papaya, kiwi, paprika, potato, and tomato).[43]

Skin Prick Test

Skin prick testing is the most reliable method of diagnosing a latex allergy; it has a sensitivity of 90% to 95% .[44] Skin prick testing may cause anaphylaxis, and testing should therefore be performed by a trained allergist in a hospital setting with adequate resuscitation equipment available. Although skin prick testing is the most common in vivo test, it has several limitations.[5] There are few commercially available skin test solutions with acceptable clinical sensitivity and specificity, such as Stallergen,[45] Bencard,[46,47] and a nonammoniated preperation from DPC.[48]

Exposure Test

Glove Wearing Tests. The patient or subject is usually asked to put on latex gloves for about 15 min, and after an additional 15 min clinical symptoms are recorded. The test can be combined with an inhalation challenge by release of glove powder.[43]

Ocular Challenge Tests. Ocular challenge test represent a safe method for assessing latex allergy.[49]

Inhalation Challenge Tests. The ultimate proof of respiratory latex hypersensitivity is provide by inhalation latex challenge. In occupational medicine, workplace-related exposure tests are the gold standard for diagnosis of occupational NRL asthma and/or rhinitis. Because of the risk involved for the patient, such as tests should only be performed in specialized laboratories.[43]

A proposed flow chart for the stepwise diagnosis of these disorders is provided in Figure 2.

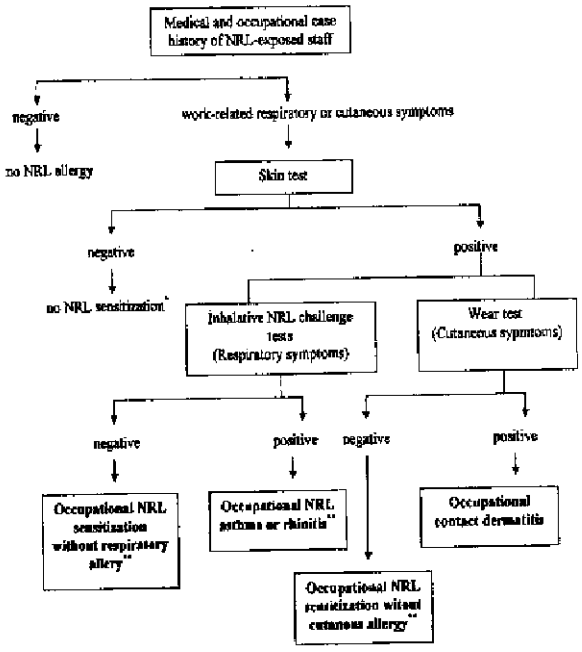

Figure 2. Suggested procedure for the stepwise diagnosis of NRL allergy (Czuppon, Allmers and Baur (2000)).

MANAGEMENT

Once a person has been diagnosed with a latex allergy, the treatment is centered on avoidance of all latex products. Such a patient should be encouraged to wear a medical alert bracelet to indicate the allergy, and he or she should also carry an epinephrine self injection kit at all times.[5]

Latex-allergic patients should be treated as the first cases of the day, before high levels of aerosolized latex proteins are present in the treatment area. Every health care facility, including dental offices and ambulatory surgery centers, should have a latex-free policy manual and latex-free cart to simplify management of latex-allergic patients.[5]

Premedication with antihistamines and corticosteroids has been suggested when a patient with spina bifida or a history of latex allergy is being treated. Premedication may reduce the severity of an allergic response in case of inadvertent latex exposure; however, it should not be considered to suggest that premedication can prevent anaphylaxis.[5,50]

The treatment of latex reactions is based on severity. In all cases the first step is removal of the allergen. Mild reactions may be treated with antihistamines, corticosteroids.

PREVENTION

The keystone of prevention should be primary prevention strategies aimed at controlling NRL exposure in order to avert IgE sensitization and asthma.[51]

Secondary prevention involves identification of disease at an early stage in order to minimize long-term impairment and disability. The high prevalence of NRL allergy among exposed workers justifies regular medical surveillance by immunological assessment and questionnaire.[9,52]

CONCLUSION

Allergic reaction to latex, including life-threatening responses, are becoming more frequent amongst all health care workers and the increasing use of rubber gloves by dentist may well result in a growing number of contacts with patients exhibiting allergic reactions to the constituents of NRL products. Clearly, if dentists wish to minimize the possibility of acquired latex sensitization, then they should choose gloves that are powder-free, low in residual accelerators and extractable latex proteins. A number of ìlow allergyî gloves are available in the marketplace but it is important to appreciate that a latex glove labeled as ìhypoallergenicî may not always prevent adverse reactions.

Dentists must be able to recognize and treat latex exposure emergencies. With adequate knowledge and preparation, health care providers can minimize the risk of adverse latex reactions.

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