Journal of Korean Academy of Nursing (2000) Vol.30, No.7

Adverse Reactions to Surgical Latex Gloves in Korea

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Abstract

This study was conducted to determine the prevalence rate of adverse reactions to latex gloves. The study compared allergic reactions to ordinary latex gloves with four types of hypoallergenic gloves among operating room nurses at a teaching hospital in Seoul, Korea. Data were collected from 63 operating room nurses by a questionnaire and direct observation of a skin prick test. Among respondents, 25 nurses with adverse reactions to latex gloves were selected for the skin prick and exposure tests with five latex gloves (1 ordinary glove, and 4 hypoallergenic gloves) using a repeated measures design of counterbalancing method.

Study Results are as follows: (1) The response rate of the questionnaire was 96.8%, and the prick test was performed in 61 out of 63 nurses. (2) Common symptoms of allergic reactions to latex gloves were rash (49.2%), skin itching (44.3%), dizziness (31.1%), and eye itching (26.2%). (3) The prevalence rate of adverse reactions was 80.3%, and that of latex allergy was 9.8%. (4) Atopic subjects had more latex allergy than the non-atopics. (5) There was no difference in the incidence rate of latex allergy among the five gloves by the skin prick test. But with the skin exposure test, ordinary latex gloves had a higher incidence rate of latex allergy than the hypoallergenic gloves ($p<0.0001$).

Key words : Latex adverse reaction, Latex allergy, Atopy, Latex glove

Introduction

Health care providers have high risks for the adverse reactions to latex due to frequent use of latex. Symptoms of latex allergy vary from localized symptoms such as urticaria, bronchial asthma, rhinitis to systemic anaphylactic reactions, causing even death. Rubber gloves containing larger amount of latex proteins have been reported to have more adverse reactions than other latex products (Tomazic, Withrow, Fisher, & Dillard, 1992). There are two types of latex sensitivity: immediate type I reaction so called latex allergy and delayed type IV reaction. If persons having type IV delayed hypersensitivity to rubber additives are exposed to latex for a long time such as wearing latex gloves, water-soluble latex proteins are absorbed

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Received 14 August 2000; Accepted 26 November 2000.

through the skin. As result, they can be sensitized and have latex allergy (Steelman, 1995). Especially, it should be emphasized that more than 80% of the people who develop type I latex allergy had type IV reactions initially (Gritter, 1998).

It was found that operating room nurses and surgeons have higher incidence rates of latex allergy than other health care providers and the general public (Turjanmaa, 1987; Turjanmaa & Reunala, 1988). Previous studies have found that the prevalence rates of latex allergy range from 5.6 to 12.5% in operating room nurses, 6.6 to 7.4% in surgeons, 2.9% in hospital personnel working at general wards, and less than 1% in the general public (Charpin, Lagier, Lhermet, & Vervloet, 1991; Lagier, Vervloet, Lhermet, Poyen, & Charpin, 1992; Turjanmaa, 1987). Since the 1980s, the number of AIDS patients and immunosuppressed patients have increased and health care providers have used more latex gloves during their medical procedures. Over time this has resulted in the incremental prevalence of latex allergy in health care providers (Baker, 1999).

The Nursing Intervention Classification (NIC) developed by the Iowa University research team has listed latex precautions as one of nursing interventions (McCloskey & Bulechek, 1995). Latex allergy has been accepted as a Nursing Diagnosis by the Association of Operating Room Nurses (AORN, 1999). This is one indicator that clearly demonstrates how nurses regard and recognize the importance of adverse reactions to latex in nursing practice.

Primary protection from latex allergy is to avoid the exposure to latex. In practice, this is impossible for health care providers. Health care professionals may choose to use hypoallergenic gloves. However, it is questionable that hypoallergenic gloves are effective in protecting latex allergy. In Korea, there have been few studies conducted on the effectiveness of hypoallergenic gloves in decreasing allergic symptoms related to latex.

This study was conducted to determine the prevalence of adverse reactions to latex and the related factors among operating room nurses as known high-risk group. Furthermore, the study explores the number and degree of allergic reactions from latex glove use. Five latex gloves were compared by the skin prick and skin exposure tests. Findings from this study should contribute to the wellbeing of health care providers and patients who have a high risk for latex hypersensitivity.

The purposes of this study were:

1. To determine the prevalence of adverse reactions and allergy to latex gloves among operating room nurses
2. To identify clinical manifestations associated with adverse reactions to latex among operating room nurses
3. To identify risk factors for adverse reactions and allergy to latex gloves
4. To compare the allergenic properties of 5 different brands of latex gloves (one set of regular latex gloves and four sets of hypoallergenic gloves) by skin prick and skin exposure tests

Literature Review

Many nurses have worn latex gloves while at work. There were few reports of latex allergy in the medical and nursing literature before 1980. However, reports have been escalated since then. Latex allergy or hypersensitivity is now recognized as a health problem and an occupational risk for health care workers. Currently, there are over 40,000 products on the market that are made with natural rubber latex (Baker, 1999). The majority of these are medical devices and the product most often associated with latex allergy is the latex glove (Gritter, 1998).

Adverse reactions associated with latex gloves and other products include two types of hypersensitivity and contact dermatitis. First, the type I reaction is the only true allergic reaction to latex proteins. It is immunoglobulin E-mediated, immediate type. And it is generally accepted that the development of contact dermatitis or a type IV reaction may indicate the potential for progression to a type I reaction. Second, the type IV hypersensitivity is a

cell-mediated, chemical and delayed type. It is a reaction to the chemicals used during the processing of latex rather than latex itself, and is not a latex allergy. The reactions may be delayed, occurring one to 48 hours after exposure, which can make diagnosis difficult. The symptoms are mostly localized. Redness and itching are major symptoms. Contact dermatitis is an irritant reaction to the chemicals used during the processing of the latex or to the powder added to latex gloves for easier donning (Steelman, 1995).

The symptoms of Type I reaction, so-called latex allergy can vary because of the variety of different latex proteins and the degrees of individual sensitivity. The degree of sensitivity can increase with continued exposure to latex. Symptoms of latex allergy may be localized or systemic. They can include urticaria, itching, rash, generalized edema, wheezing, bronchospasm, breathing difficulty, laryngeal edema, diarrhea, nausea, hypertension, tachycardia, arrhythmia, and even respiratory or cardiac arrest (Bierman, Pearlman, Shapiro, & Busse, 1995; Downing, 1933; Fisher, 1986; Kelly et al, 1994; Reis, 1994; Sussman & Beezhold, 1995; Swanson, Bubak, Hunt, & Reed, 1992).

The exact mechanism of latex sensitization is unknown. The high risk population for latex allergy include children with spina bifida, and people who have had multiple surgeries, especially genitourinary surgery. Those who have received many invasive tests or treatment have higher risks for latex allergy and therefore are subject to hypersensitivity (Leynadier, Pecquet, & Dry, 1989; Turjanmaa, 1987). People with atopy, people who currently have allergies, workers in any job that regularly requires latex glove uses, and workers in industries that manufacture latex are also at increased risk. Atopic persons have a genetic predisposition for allergic conditions such as asthma, eczema, or hay fever. Frequently, these atopic persons or people with latex allergy are cross-reactive to certain foods such as avocados, bananas, kiwifruit, chestnuts, and pineapples (Steelman, 1995; Gritter, 1998). Health care workers are also a high risk group because chronic exposure to latex-containing products may cause irritation, localized allergic reactions, or systemic allergic reactions (Turjanmaa, 1987; Turjanmaa & Reunala, 1988). Other related factor to latex allergy is gender. The prevalence in females is higher than in males because of female hormones (Slater & Kaliner, 1987).

There are five recognized routes of latex exposure, which are cutaneous, percutaneous, mucosal, parenteral, and aerosal exposure. Among them, mucosal exposure presents a great risk for persons with latex allergy. Its sources include urinary catheters, surgical exposures to gloves, and food. Aerosolizaed latex is of particular concern because the powder carrying the latex proteins can remain airborne. This kind of latex exposure linked to occupational asthma in the workplace.

Methods for diagnosing latex allergy include history taking, skin prick test, patch test, and radioallergosorbent test (RAST). Management of latex allergy starts with immediate removal of the cause. It requires the exclusive use of non-latex products during treatment and the elimination of airborne allergens from the environment. Treatment may include administration of antihistamines, epinephrine, intravenous fluids, corticosteroids, oxygen, and may even necessitate intubation. The only sure prevention is avoidance of all latex products.

Methods

This study was performed from 1 November 1995 to 1 December 1996. The study was divided into 3 phases:

Phase Ⅰ

Phase I consisted of distributing survey questionnaires to 63 operating room nurses at a teaching hospital in Seoul, Korea. Of the 63 nurses, 61 (98.3%) completed and returned the questionnaire. The questionnaire developed by the authors, was validated by a team of experts composed of a professor at the school of nursing, a medical doctor who specializes in allergies and five Operating Room (OR) nurses. The questionnaire contained questions on demographic information, the risk factors such as the duration

of exposure to latex, smoking, previous disease history (allergies related to medications/food/cosmetic powders/others, asthma, chronic illness, surgery history) and signs and symptoms of adverse reactions to latex products. Symptoms of the adverse reactions included dermatologic, respiratory or asthmatic, rhinologic, otologic, circulatory problems, and others which may have occurred from exposure to latex gloves.

Phase Ⅱ

In phase II, 61 OR nurses were tested to identify latex allergy and atopy using the prick test. For this test five latex antigens were extracted from five rubber gloves (Skin Angel, hypoallergenic HAG, hypoallergenic SmooTer-R, hypoallergenic Candle, hypoallergenic Neutralon) for latex allergy and 10 common inhalative antigens (Dermatophagoides farinae, Dermatophagoides pteronyssinus, Alternaria, Aspergillus, grass pollen mixture, tree pollen mixture, mugwort, ragweed, cat fur, cockroach) for atopy. These gloves were on use at the study hospital. The authors applied a drop of the concentrated allergens on the forearm or back, and continued pinpricking with a needle. After 20 minutes observations were recorded. If the mean size of wheal and flare to an applied antigen was more than that of histamine, the test was considered positive. Histamine (10mg/ml) was used as a positive contrast, and saline diluents as the negative contrast.

Phase Ⅲ

In phase III, 25 nurses were studied, including those who reported adverse reactions to latex gloves or those who were identified to have an allergy or atopy to latex. Allergenic properties of ordinary latex and four hypoallergenic gloves were compared using the skin exposure test by repeated measures design with counter-balancing method. Each subject wore the five separate gloves in different order. Participants wore one glove for at least one hour before being assessed for signs or symptoms of the adverse reactions to a specific latex glove. At least a one-day interval was given before testing the next glove to remove any carry-over effects. Any possible allergic reactions were observed by the authors and a physician to ensure interrater reliability (100%).

Data Analysis

Data were analyzed using SPSS-PC+. General characteristics and clinical manifestations were tabulated using a descriptive procedure. The relationships between the factors related to latex adverse reactions and prevalence of adverse reactions to latex were analyzed by the t-test and chi-square test. The relationships between the related factors to latex allergy and the prevalence of allergy were also analyzed using the t-test and chi-square test. Allergenic properties of one ordinary latex glove and four hypoallergenic gloves were compared using the Cochran Q test.

Results

Demographics

Characteristics of the study subjects are shown in Table 1. The age of the subjects ranged from 21 to 51 years (mean 28.2 years). All subjects were female and had worked in operating room (OR) for a mean of 65.1 months. The mean total hours of scrub per day was 4.0 hours, and the mean number of scrubs for a day was 1.9. The value of zero′ represents they had no scheduled surgery due to unexpected cancel of scheduled operations, formal hospital meetings, and so on. Of the 61 nurses who participated in this study, seven (11.5%) experienced previous exposure to allergic reactions. Six of the subjects had

Table 1. Characteristics of Study Subjects (n=61)

Variables	Mean(SD)	Range	Frequency
Age(year)	28.2(5.28)	21-51	
Length of work(month)	65.1(52.3)	6-240	
Scrub time(hour/day)	4.0(0.83)	0-6	
Scrub frequency(/day)	1.9(0.58)	0-3.5	
Previous disease history	Allergy-related		6(9.8%)
	Surgery		1(1.7%)
	No		54(88.5%)

allergies to food or personal accessories made of metals and one had a history of thyroid surgery.

Prevalence and clinical manifestations of adverse reactions or allergy to latex

Out of 61 participants, 49 (80.3%) reported having had an adverse reaction to the latex glove. The symptoms associated with wearing latex glove were rash (49.2%), skin itching (44.3%), dizziness (31.1%), eye itching (26.2%), rhinorrhea (19.7%), sneezing (18.0%), dyspnea (18.0%), eczema (16.4%), nasal itching (16.4%), urticaria (14.8%), eye congestion (11.5%), and otorrhea (10%).

Twenty-five of the subjects showed atopic, and 6 (9.8%) had a positive response to the allergen test. Among subjects with a positive response, five were atopic and one non-atopic.

Factors related to adverse reactions or allergy to latex allergen

The nurses who had an adverse reaction to latex gloves reported exposure duration to latex of 63.2 months (ranging 6-40 months). There was no difference in exposure time found between nurses who had an adverse response to latex (63.2 months) and those who did not have a reaction (72.8 months) (Table 2).

Table 2. Adverse Reaction and Exposure Duration to Latex

Adverse Reaction	Exposure Duration(months)	t	p-value
Positive(n=49)	63.2 ± 52.2*	-0.545	0.593
Negative(n=12)	72.8 ± 54.6*		

* Mean ± Standard Deviation

The relationship between the adverse reaction to latex and atopy was analyzed. There was no statistically significant relationship between atopy and adverse reaction to latex (Fisher's exact test p=0.328) (Table 3).

The relationship between previous disease history and the adverse reaction to latex glove was analyzed and no statistically significant relationship was found between previous disease history and the adverse reactions to latex (Table 4).

Table 3. Adverse Reaction to Latex and Atopy

Atopy	Adverse Reaction		Sum(%)
	Positive	Negative	
Atopics	22	3	25(41.0)
Non-atopics	27	9	36(59.0)
Sum(%)	49(80.3)	12(19.7)	61(100)

Fisher's exact p = 0.328

Table 4. Adverse Reaction to Latex and Previous Disease History

Disease history	Adverse reaction		Sum(%)
	Positive	Negative	
Yes	7	0	7(11.5)
No	42	12	54(88.5)
Sum(%)	49(80.3)	12(19.7)	61(100)

Fisher's exact p = 0.327

The mean reported exposure duration to latex was 62.5 months in the nurses who had the latex allergy to the latex gloves, and 66.7 months in the nurses who did not have the latex allergy to the latex gloves. This difference was not statistically significant (Table 5).

Table 5. Latex Allergy and Exposure Duration to Latex

Allergy	Exposure Duration(months)	t	p-value
Positive(n=6)	62.5 ± 31.3*	0.28	0.783
Negative(n=55)	66.7 ± 53.7*		

* Mean Standard Deviation

The prevalence of latex allergy was 2.8% in non-atopics and 20% in atopics. Atopic subjects had a statistically higher prevalence of latex allergy than no atopic subjects (Fisher's exact test p=0.038) (Table 6)

Table 6. Latex Allergy and Atopy

Atopy	Allergy		Sum(%)
	Positive	Negative	
Atopics	5	20	25(41.0)
Non-atopics	1	35	36(59.0)
Sum(%)	6(9.8)	55(90.2)	61(100)

Fisher's exact p = 0.038

The relationship between previous disease

history and latex allergy was examined. In the group with a previous disease history, 14.3% had the latex allergy, while in the group without a previous disease history 9.3% had the latex allergy. The difference was not statistically significant (Fisher's exact p=1.000) (Table 7).

Table 7. Latex Allergy and Previous Disease History

Disease history	Allergy		Sum(%)
	Positive	Negative	
Yes	1	6	7(11.5)
No	5	49	54(88.5)
Sum(%)	6(9.8)	55(90.2)	61(100)

Fisher's exact p = 1.000

Comparison of allergenic properties in one ordinary and four hypoallergenic latex gloves

The skin prick and the skin exposure tests were performed on 25 operating room nurses who experienced adverse reactions to latex or were identified to have an allergy or atopy to latex. The sample included six nurses with latex allergy. The incidence rate of latex allergy for ordinary gloves was 16% by the skin prick test and 48% by the skin exposure test. When the four hypoallergenic gloves were worn, incidence rates of latex allergy with the skin prick and exposure tests were 8% and 24% for A gloves; 12% and 4% for B gloves; 8% and 0% for C gloves; and 8% and 24% for D gloves. There was no statistically significant difference in rates of latex allergy among the 5 gloves in terms of incidence rates of latex allergy tested by the skin prick test (Cochran Q=3.556, p=0.470). However, the incidence rates of skin allergy were significantly different among the 5 gloves when tested by the skin exposure test (Cochran Q=31.724, p<0.0001). Ordinary latex gloves had a higher incidence of latex allergy than hypoallergenic gloves. Among the hypoallergenic gloves, the reactions to A and D were not significantly different (p=1.0). Similarly, the reactions between glove B and C were not different (p=0.317). However, the reactions from A and B, A and C, B and D, and C and D were significantly different (Table 8).

Discussion

In this study the questionnaire response rate was 96.8%. The skin prick tests were performed on 61 nurses with five latex allergens and ten common inhalative antigens. Of 61 OR nurse participants, 49 (80.3%) nurses reported adverse reactions to latex gloves, 6 (9.8%) nurses reported having the latex allergy, and 25 (41.0%) nurses were found atopic.

Common symptoms of adverse reactions to latex gloves were rash, skin itching, dizziness, and eye itching. The prevalence rate of adverse reactions to the latex glove was 80.3%. The adverse reactions to latex was not related to duration of exposure to latex gloves (p=0.593), atopy (p=0.328), and the previous disease history (p=0.327). The prevalence rate of latex allergy was 9.8%. The relationship between the latex allergy and atopy was significant (p=0.038), i.e. the atopic subjects had more latex allergy than the non-atopics. However, the latex allergy was not related to exposure duration (p=0.783) and the subject's previous disease history (p=1.000).

The first time the subjects experienced allergy

Table 8. Incidence of Latex Allergy by Glove Types (n=25)

Gloves	Prick test		Exposure test	
	Positive No(%)	Negative No(%)	Positive No(%)	Negative No(%)
Usual	4(16)	21(84)	12(48)	23(52)
Hypoallergenic				
A	2(8)	23(92)	6(24)	19(76)
B	3(12)	22(88)	1(4)	24(96)
C	2(8)	23(92)	0(0)	25(100)
D	2(8)	23(92)	6(24)	19(76)
p-value	p=0.470		p<0.0001	

symptoms related to latex gloves varied from 3 months to 2.5 years after they began work in the operating room. These results are similar to those found in Turjanmaa (1987) and Charpin et al. (1991) studies. These results and findings from other investigators appear to indicate that the allergic reactions to latex seem to be widespread. This prevalence of adverse reactions to latex glove use (80.3%) indicated a mixed presence of Type IV and Type I hypersensitivity.

The most common symptom of adverse reactions in this study was nonimmunologic irritant dermatitis (44.3%). Because Ig E-mediated latex allergy can cause local contact urticaria, occupational nasoconjuctivitis, and asthma, the additional methacholine bronchial provocation test was performed in the 6 nurses who had the latex allergy. One person reported having bronchial asthma. In this study, none of the nurses reported having a severe anaphylactic reaction to latex. The most serious reactions that were reported occurred in the case of sensitizing by mucosal exposure from an operation or barium enema (Seggev, Mawhinney, Yunginger, & Braun, 1990; Slater, 1992; Tomazic et al., 1994). In this study two participants had dermographism but were identified as negative latex allergy by the inhalative test.

The allergy to ethylene oxide (a chemical treatment for glove sterilization) was not investigated in this study. Pittman, Kiburz, Steinhardt, Krock, & Gabriel (1995) reported that subjects with the ethylene oxide-allergy had a greater propensity for developing the latex allergy. The symptoms, such as urticaria, angioedema, bronchial spasm, cardiovascular collapse etc, were common in the reactions to ethylene oxide and latex allergens.

The relationships between known risk factors and adverse reactions to latex were not significant. Also, the relationships between risk factors and latex allergy were examined, and only atopy was significantly related to the latex allergy. Zada, Reeder, Charles, & Jarvis (1994) reported allergies to cosmetic powders, chronic illness and unpowdered surgical gloves as risk factors. One of several possible explanations for finding only atopy as a significant risk factor could be that the subjects with known risk factors were very small in this study. The exposure duration to latex was measured by the length of work because study subjects were homogeneous in terms of scrub frequency and scrub time a day. Another related factor was gender. Females had a higher prevalence of latex allergy than males (Slater & Kaliner, 1987). This may have been due to the fact that female hormones increase the emission of histamine (Slater & Kaliner, 1987). In this study all subjects were females, thus any comparison between the sexes could not studied.

Recently, the production of hypoallergenic latex gloves and non-latex gloves has increased. There was no difference in prevalence rates of latex allergy among gloves by the skin prick test ($p=0.85$). From the results of the skin exposure test, ordinary latex gloves had a higher incidence rate of latex allergy than hypoallergenic gloves ($p<0.0001$). In this study, the allergic reaction rate to the ordinary latex glove was higher than the hypoallergenic gloves. However, only two of the hypoallergenic gloves tested had a significantly lower incidence of allergic reactions than ordinary gloves. Hypoallergenic gloves are expensive due to the special treatment. Thus, more studies need to be conducted to test the effectiveness of hypoallergenic latex gloves in larger populations among other types of gloves.

Conclusions

Adverse reactions to surgical latex gloves in operating room nurses were not rare in Korea. About 80% of them had complained discomfort related to wearing latex glove. People with type IV reactions initially have a more tendency to develop latex allergy. Therefore, prevention strategies for them as well as latex allergic people must be developed and instituted to protect latex-sensitive health care workers.

In nursing practice, nurses need to be able to identify and be aware of all latex products used. Also, clients or patients who have high risk factors that may produce allergic reactions need to be documented. If possible, the nurse should replace latex products with non-latex products. Once systemic symptoms and signs occur, nurses

should report the information to other medical personnel and administer drugs (epinephrine etc.). Additionally, nurses can educate the patients and families about products containing latex, allergy symptoms, the risk factors, potential allergy reactions, and emergency treatment.

Ethylene oxide as an allergen was not examined in this study and also needs to be explored in a subsequent study. This study only examined nurses and further study needs to examine the extent to which latex is used in patient care among other health professions. In Korea latex allergy is becoming a great concern, and staff and patient education are needed.

Also, nurses should know the items that contain latex before any application and be able to differentiate the signs and symptoms that latex may present in order to ensure the safety of patients, especially having atopic. At the least, medical personnel should consult with other healthcare professionals to ensure patient safety and health.

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