

LATEX ALLERGY AND LATEX-FRUIT SYNDROME AMONG MEDICAL WORKERS IN TAIWAN

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Background and Purpose: Latex allergy is a serious occupational health problem among medical workers, but there are few data regarding its incidence and clinical characteristics in Taiwan. No data on the latex-fruit syndrome in Taiwan have been reported. This study investigated the prevalence of both latex allergy and latex-fruit syndrome, and risk factors for the development of latex allergy among medical workers.

Methods: A total of 302 medical workers who had daily contact with latex gloves during work at three hospitals in central Taiwan were interviewed and screened by questionnaire to detect allergic reactions to latex. Those with a history of immediate allergic reaction to latex gloves were screened for specific IgE antibodies against latex. Subjects whose screening results were positive were considered to have immediate latex allergy. Latex-fruit syndrome was defined as a clinical condition that manifested as immediate allergic reactions to both latex and fruit.

Results: Twenty-six (8.6%) medical workers had immediate allergic reactions to latex. The severity of latex allergy was correlated to the serum level of latex-specific IgE. Seven subjects with latex allergy (26.9%) had latex-fruit syndrome. Risk factors for development of latex allergy among medical workers were latex glove-related hand dermatitis, fruit allergy, preexisting atopic disease, hospital employment for more than 2 years, and total exposure to latex gloves of more than 9,000 hours.

Conclusion: Latex allergy is an underrecognized occupational health problem in Taiwan. Early identification of medical workers at high risk is important so that they can be advised to use non-latex gloves as early as possible to prevent further sensitization to latex proteins.

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Latex is a natural derivative of *Hevea brasiliensis*. It is a common component of many medical supplies such as disposable gloves, artificial airways, intravenous tubes, syringes, stethoscopes, catheters, dressings and bandages. With the increasing use of latex gloves as a protective barrier against infection among hospital staff, the incidence of immediate allergic reaction to latex has been increasing rapidly and has become the most important occupational allergy among medical workers in Western countries [1-3].

The development of contact dermatitis, either allergic or irritant, after wearing latex gloves is a well-recognized problem among medical staff. Immediate allergy to latex gloves is a more recently acknowledged

problem that was first reported by Nutter in 1979 [4]. Immediate allergic reactions usually appear within 1 hour of contact with latex products, and are due to proteins present in the natural rubber latex. The symptoms of immediate latex allergy vary from urticaria, rhino-conjunctivitis, angioedema and asthma, to life-threatening anaphylactic shock. At least 15 fatalities due to anaphylaxis to latex have been reported [5-7]. Prevalence rates of latex allergy among healthcare personnel range from 2.8 to 10.7% in Europe, and from 5.5 to 16.9% in the USA [8-14]. The prevalence of immediate reactions to latex gloves among hospital medical employees was 6.8% in a single hospital study in Taiwan in 1997 [15]. Once a worker is sensitized and

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has had an allergic reaction to latex allergens, continued exposure may result in progressive morbidity, and possibly mortality, from anaphylactic reactions.

Individuals with latex allergy have been reported to be more frequently allergic to certain fruits and vegetables because of cross-reactivity of the allergens, known as latex-fruit syndrome [16]. Recent studies suggest that the major cross-reactive allergens of latex-fruit syndrome are latex profilin and class I chitinases [17, 18]. No data regarding latex-fruit syndrome in Taiwan have been reported.

This study investigated the prevalence of latex allergy, latex-fruit syndrome, and the risk factors related to the development of latex allergy among Taiwanese medical workers.

Materials and Methods

A total of 302 medical workers who wore latex gloves during their daily work at one of three hospitals in central Taiwan, including Taichung Veterans' General Hospital, Chung-Shan Medical College Hospital and Chen-Ching Hospital, were enrolled in this study. Subjects included 45 surgeons, 11 anesthesiologists, 22 dentists, 149 operating room nurses and 75 laboratory technicians. There were 69 men and 233 women with a mean age of 29.79 ± 6.35 years (range, 18–60 yr).

Subjects were interviewed by a doctor or nurse specialist using a screening questionnaire. Gender, age, job category, years of employment, mean hours of exposure to latex gloves per week, and history of atopy were recorded. Atopy was defined as the existence of allergic rhinitis, allergic asthma or atopic dermatitis. All immediate allergic reactions (within 1 hour of exposure) were recorded, including anaphylaxis, asthmatic attack, urticaria, angioedema, sneezing, nasal congestion, and itchy watery eyes after exposure to latex gloves. Subjects who reported itching, vesicle formation, or drying and fissuring of the skin after using latex gloves were considered to have latex glove-related hand dermatitis, regardless of whether it was irritant or allergic in nature. Immediate allergic reactions, including anaphylaxis, acute bronchospasm, urticaria, angioedema, oral mucosal swelling, sneezing, nasal congestion, and itchy watery eyes, all within 1 hour of consuming fruits and vegetables including avocado, apple, pear, kiwi, papaya, pineapple, peach, cherry, plum, apricot, banana, melon, nectarine, grape, fig, passion fruit, tomatoes, celery, carrot, hazelnut, chestnut and potatoes, were also recorded.

Blood was collected at the time of the interview if the subject reported immediate allergic reactions after

wearing latex gloves. Serum was tested for specific immunoglobulin E (IgE) against latex (CAP, Pharmacia Diagnostics, Uppsala, Sweden). A positive result was defined as at least 0.35 kU/L. Subjects who had both a history of immediate allergic reaction to latex gloves and positive specific IgE against latex were considered to have latex allergy. Latex-fruit syndrome was defined as a clinical condition that manifested as immediate allergic reactions to both latex and consumption of fruit.

Statistical analyses were performed using SPSS for Windows Version 8.0 (SPSS, Inc, Chicago, IL, USA). Mann-Whitney U test, Pearson's Chi-square test, and Fisher's exact test were used to evaluate the associations between latex allergy and variables.

Results

Twenty-six of 302 (8.6%) medical workers had immediate allergic reactions to latex. Ninety-five workers (31.6%) had latex glove-related hand dermatitis. The symptoms of immediate allergic reactions to latex and levels of latex-specific IgE are listed in Table 1. Subjects with more severe symptoms of allergy such as asthma, angioedema and anaphylactic shock, had significantly higher levels of latex-specific IgE.

Seven of the 26 (26.9%) medical workers had latex-fruit syndrome. Those with latex-fruit syndrome were older than those with immediate allergic reactions to latex (mean age, 36.14 ± 6.23 yr *vs* 29.89 ± 6.33 yr, $p = 0.035$). Three of them were allergic to two kinds of fruit (jujube and grape, peach and pineapple, peach and kiwi, respectively) and four to only one kind of fruit (pineapple, melon, potato and jujube, respectively).

Risk factors for the development of immediate latex allergy are listed in Table 2. Subjects who had latex glove-related hand dermatitis (odds ratio [OR] = 72.80), fruit allergy (OR = 10.93), or atopy (OR = 6.20) were at higher risk of developing immediate latex allergy. In addition, medical workers who were employed in a hospital for more than 2 years (OR = 3.69) and exposed to latex gloves for more than 9,000 hours (OR = 2.44) were also at higher risk of developing latex allergy. Age and gender were not correlated with the development of latex allergy.

As shown in Table 3, medical workers with different job categories had different prevalences of latex allergy. Dentists and anesthesiologists (OR = 3.11) tended to develop latex allergy more frequently than staff in other job categories, although this difference was not statistically significant.

Table 1. Symptoms and latex-specific IgE levels in 26 medical workers with latex allergy

Allergic symptom		Number	Latex-specific IgE (kU/L) [†]	<i>p</i> value*
Urticaria	Yes	18	2.95 ± 5.41	0.53
	No	8	4.77 ± 10.69	
Conjunctivitis	Yes	21	4.16 ± 7.97	0.22
	No	5	0.81 ± 0.43	
Rhinitis	Yes	21	4.15 ± 7.97	0.45
	No	5	0.84 ± 0.41	
Asthma	Yes	3	16.92 ± 15.02	0.03
	No	23	1.76 ± 3.40	
Angioedema	Yes	2	17.63 ± 0.95	0.03
	No	24	2.34 ± 6.20	
Anaphylactic shock	Yes	1	31.20	< 0.0001
	No	25	2.40 ± 4.65	

*Mann-Whitney U test (nonparametric test); [†]Data are expressed as mean ± standard deviation (SD).

Discussion

The prevalence of latex allergy is increasing among medical workers, although the prevalence in the general population appears to have remained at less than 1% [19]. In this study, we found that immediate latex allergy was present in 8.6% of medical workers. A previous study by Lai et al in 1997 found that the prevalence of immedi-

ate latex allergy among medical workers in Taiwan was 6.8%, although the study population was somewhat different from the current study [15]. Their study, included more floor nurses than this study, and did not include dentists and anesthesiologists. Although there might have been selection bias to high-risk job categories in this study, Lai et al's study used a questionnaire that only considered the diagnostic criteria of latex allergy in the patient history, which tends to overestimate the prevalence of latex allergy. Hamilton et al found that the

Table 2. Risk factors for immediate latex allergy among 302 medical workers

	Latex-nonallergic (<i>n</i> = 276)	Latex-allergic (<i>n</i> = 26)	<i>p</i> value*	Odds ratio	95% CI
Sex					
Male	62 (22.5%)	7 (26.9%)	0.61	0.77	0.32–1.96
Female	214 (77.5%)	19 (73.1%)			
Age					
< 30 yr	148 (53.6%)	13 (50.0%)	0.72	1.16	0.52–2.58
≥ 30 yr	128 (46.4%)	13 (50.0%)			
Total latex exposure hours					
≥ 9,000 hr	119 (43.1%)	17 (65.4%)	0.03	2.44	1.07–5.79
< 9,000 hr	157 (56.9%)	9 (34.6%)			
Hospital employment years					
≥ 2 yr	131 (47.5%)	20 (76.9%)	0.004	3.69	1.44–9.47
< 2 yr	145 (52.5%)	6 (23.1%)			
Atopy					
Yes	84 (30.4%)	19 (73.1%)	< 0.0001	6.20	2.51–15.32
No	192 (69.6%)	7 (26.9%)			
Fruit allergy					
Yes	13 (4.7%)	7 (26.9%)	< 0.0001	10.93	3.67–32.57
No	263 (95.3%)	19 (73.1%)			
Latex glove-related hand dermatitis					
Yes	70 (25.4%)	25 (96.2%)	< 0.0001	72.80	9.74–550.32
No	206 (74.6%)	1 (3.8%)			

*Pearson's Chi-Square test. CI = confidence interval.

Table 3. Prevalence of immediate latex allergy among 302 medical workers in different job categories

Job category	Number	Latex allergy (%)	Odds ratio	<i>p</i> value*	95% CI
Surgeon	45	3 (6.67%)	1.00	—	—
Anesthesiologist	11	2 (18.18%)	3.11	0.25	0.45–21.40
Dentist	22	4 (18.18%)	3.11	0.21	0.63–15.34
OR nurse	149	11 (7.38%)	1.12	1.00	0.30–4.19
Lab technician	75	6 (8.0%)	1.22	1.00	0.29–5.13

*Fisher's exact test. CI = confidence interval; OR = operating room.

positive predictive value of latex-specific IgE as determined using the CAP system was 83%, the negative predictive value was 85.9%, and the diagnostic efficiency was 84.9% [20]. Previous studies found that the prevalence of latex allergy in Asian countries ranged from 1.5 to 6.8% [15, 21, 22]. This study found the highest prevalence rate reported from any Asian country, which may be related to the increasing use of latex gloves in Taiwan.

There was a correlation between the severity of immediate allergic reaction and serum level of latex-specific IgE. Medical workers with latex-related asthma ($p = 0.03$), angioedema ($p = 0.03$), and anaphylactic shock ($p < 0.0001$) had significantly higher levels (> 16 kU/L) of latex-specific IgE. The factors associated with increased likelihood of developing immediate latex allergy were ranked as follows: latex glove-related hand dermatitis, fruit allergy, atopy, hospital employment for longer than 2 years, and total exposure to latex gloves of longer than 9,000 hours.

Medical workers with latex glove-related hand dermatitis were at the highest risk of developing immediate latex allergy (OR = 72.80). A recent study of latex glove allergy in dental clinics in Sweden also suggested that hand eczema was a strong factor for the development of latex allergy [23]. Preexisting hand dermatitis with latex gloves may allow more latex allergens to enter the bloodstream via eczematous fissuring skin. In this study, those who were employed in hospitals for more than 2 years (OR = 3.69) and those with exposure to latex gloves for more than 9,000 hours (OR = 2.44) also had higher risk. These findings suggest that the degree of latex exposure is an important factor in the development of immediate latex allergy. In a cross-sectional study of dental students in Ontario, Canada, Tarlo et al found that the development of latex allergy was correlated with the degree and duration of exposure to latex [24]. However, the threshold level of latex exposure has not yet been elucidated.

Atopy was a significant risk factor for the development of immediate allergic reactions to latex in our study (OR = 6.20). Looking at the different prevalences of latex allergy in our study, according to job category, although dentists and anesthesiologists had a higher

rate of latex allergy than other categories of medical work (OR = 3.11, using surgeons as baseline), all latex-allergic dentists and half of latex-allergic anesthesiologists had atopy. This finding suggests that atopy might play an important role. Frequent donning and changing of powdered latex gloves in an ordinary dental and anesthetic practice, which allows more free latex proteins to exist in the air, may also be a risk factor.

Our study showed that 26.9% of medical workers with latex allergy also had latex-fruit syndrome. Whether these individuals were pre-sensitized to fruit before exposure to latex or vice versa remains unclear. We also found that two persons had cross-reaction to jujube, *Zizyphus mauritiana*, which has not been previously reported. Determining whether there are distinct cross-reactive allergens in cases of latex-fruit syndrome in Taiwan will require further study.

In conclusion, latex allergy is an emerging clinical and occupational health problem in Taiwan. Early identification of medical workers at high risk of immediate latex allergy is important. Medical workers who are at high risk of developing immediate latex allergy should avoid latex gloves whenever possible to prevent further sensitization to latex proteins.

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