

Prevalence of latex allergy in hospital staff in Hong Kong

R. LEUNG, A. HO, J. CHAN, D. CHOY AND C. K. W. LAI

Department of Medicine, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong

Summary

Background The prevalence of latex allergy in healthcare workers in Asian populations is unknown.

Methods We studied 1472 employees in a teaching hospital in Hong Kong using written questionnaires and 133 respondents underwent skin prick testing to latex glove eluates and common allergens.

Results Glove-related symptoms were common and 455 (30.9%) reported one or more symptoms, the majority of which could be classified as glove dermatitis (GD). On the other hand, symptoms suggestive of latex allergy such as urticaria, rhinitis, wheeze and asthma, were encountered less frequently and were noted by 3.3%. In particular, one developed asthma and two had wheezing, but there was no report of anaphylaxis. A total of 9.9% reported allergic symptoms from contact with other latex devices, in particular, rubber bands, rubber boots, goggles and swimming. Nine subjects (6.8%) had positive skin test to one or more of the five latex extracts. All were atopic to common allergens. Skin test positivity to latex and banana extracts was positively correlated ($P < 0.05$). In univariate logistic regression, daily glove use, personal history of allergic disease and history of allergic symptoms to latex-containing devices other than gloves were significant risk factors for both GD and LA. Nurses were more likely to complain of GD and workers with positive skin test to latex were 8.6 times more likely to have symptoms of LA. In multiple logistic regression, the remaining significant associations were between history of daily glove use and GD (OR = 50.11, 95% CI 15.88–158.13), and between positive latex skin test and LA (OR = 8.14, 95% CI 1.27–52.36).

Conclusion Glove-related symptoms are common in healthcare workers in Hong Kong. Gloved healthcare workers are at risk of becoming sensitized to latex, and those with positive latex skin tests, long glove exposure time and frequent glove changes are at risk of clinical latex allergy.

Keywords: latex allergy, Hong Kong, epidemiology, allergy, atopy, skin test, asthma, rhinitis, eczema, dermatitis

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Introduction

Since the first description of contact urticaria to rubber gloves in 1979 [1], latex allergy has become a central problem for healthcare workers and latex manufacturers. It is now estimated that between 5 and 10% of healthcare workers are allergic to latex [2] and those at greatest risks are theatre nurses, surgeons and dentists. Other high risk

groups include people who undergo frequent surgical procedures, patients with spina bifida requiring long-term bladder catheterization, those who work in the rubber industry, children who play with rubber toys and balloons, and housewives who use rubber gloves. The majority of reactions in hospitals related to latex exposure were due to latex gloves or bladder catheters, but other devices such as adhesive tapes, piston syringes and intravascular administration sets have also been implicated [3].

Type I hypersensitivity reactions are mediated by specific IgE to a number of latex proteins with molecular weights

Correspondence: Dr Roland Leung, Associate Professor, Department of Medicine, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong.

ranging from 2 to 100 kD [4]. The diagnosis of latex allergy is based on clinical history and the presence of specific IgE to latex allergens by skin prick test with eluates from latex gloves and serologic tests such as RAST inhibition and ELISA inhibition tests [5]. Whilst the manifestations of glove dermatitis characterized by dryness, pruritus and redness developing several hours to days after glove exposure are common and are reported by 30–40% of the population who wear gloves, these symptoms are caused by irritation or type IV hypersensitivity to rubber chemicals and are not features of latex allergy [6].

There are currently no data on the prevalence of latex allergy in Chinese populations in Asian countries. In this study, we determined the prevalence of latex allergy by questionnaire and skin prick test amongst healthcare workers in a large teaching hospital in Hong Kong.

Subjects and methods

Each of the 2000 hospital employees at the Prince of Wales Hospital in Hong Kong were sent a questionnaire on the use of latex gloves and adverse reactions related to glove wearing. Glove dermatitis (GD) was defined as dryness and/or pruritus and/or redness in the absence of urticaria. Latex allergy (LA) was defined as one or more of urticaria, rhinitis, wheeze or asthma occurring within 2 h of glove use. Information was also obtained on personal history of atopic disease, and previous allergic reactions to other latex devices, as well as foods known to cross-react with latex allergens, including banana, nuts and avocado [7,8]. Each questionnaire respondent was asked to undergo skin prick testing at the Respiratory Laboratory on a later date. The extraction of elutable latex proteins from latex gloves was performed according to the protocol by Turjanmaa [9], which involved cutting 1 g of glove into small pieces and soaking them at room temperature in 5 ml of normal saline for 15 min. All the five different types of gloves available in the hospital were used to prepare skin test solutions. The characteristics of the gloves are shown in Table 1. Other allergen extracts (Dome-Hollister, Spokane, Washington) employed in skin testing were house dust

mite (*D. pteronyssinus*, *D. farinae*), house mould (*alternaria*, *cladosporium*, *penicillium*, *aspergillus* spp.), cat and dog dander, cockroach mix (Oriental, American, German spp.), Bermuda grass pollen, ragweed pollen, banana, avocado and nuts. Skin prick tests were performed according to Pepys' method [10] using histamine (10 mg/ml) and normal saline as positive and negative controls respectively. Wheals of 3 mm or greater were regarded as positive in the absence of a reaction to normal saline and subjects with one or more positive reactions were considered atopic.

Statistical analysis

The chi-squared test was used to assess the association between categorical variables. Logistic regression was performed to demonstrate the associations of GD and LA with selected risk factors for GD and LA (history of daily glove use, personal history of allergic disease, history of allergic symptoms related to non-glove latex devices, atopy, positive skin test to latex extracts) which were treated as categorical variables and the associations were calculated by logistic regression. The relationships of GD and LA with glove exposure time and number of glove changes in a day were calculated by the test of proportion.

Results

A total of 1472 questionnaires were returned completed, representing a response rate of 73.6%. The questionnaire response is shown in Table 2. The majority of the respondents were female (78.9%), nursing staff of the hospital (69.1%), and aged 20–40 yr (84.9%). More than half spent most of their working days in hospital on the wards. Fifty-three per cent of the respondents used rubber gloves daily, with a daily exposure time of about 1.5 h for both sterile and non-sterile gloves. Personal history of allergic disease was common, with allergic rhinitis, eczema and asthma affecting 28.1%, 20.9% and 4.1% of the subjects respectively. Although one out of six respondents claimed to have food allergy, foods that allegedly have allergenic cross-reactivity with latex allergens such as banana, avocado and nuts, were not common food allergens.

Table 1. Characteristics of latex gloves used in skin testing

	Sterile	Pre-powdered	Disposable	Manufacturer
Glove A	—	—	+	China
Glove B	—	+	+	China
Glove C	—	—	—	China
Glove D	—	+	+	Taiwan
Glove E	+	—	—	China

Table 2. Questionnaire response

	Number	%	95% confidence intervals
<i>Response rate</i>	1472	73.6	
<i>Sex</i>			
Female	1161	78.9	76.8–81.0
Male	306	20.8	18.7–22.9
<i>Age</i>			
< 20	71	4.8	3.7–5.9
20–40	1249	84.9	83.0–86.7
> 40	136	9.2	7.8–10.7
<i>Occupation</i>			
Nurse	1017	69.1	66.7–71.5
Allied health	76	5.2	4.0–6.3
Doctors	61	4.1	3.1–5.2
Administrative staff	123	8.4	6.9–9.8
Unspecified	195	13.2	11.5–15.0
<i>Place of work in hospital</i>			
Ward	843	57.3	54.7–59.8
Outpatient	152	10.3	8.8–11.9
ICU	89	6.0	4.8–7.3
Operation room	73	5.0	3.9–6.1
Laboratory	91	6.2	5.0–7.4
Unspecified	242	16.4	14.5–18.3
<i>Daily glove wearing</i>	781	53.1	50.5–55.6
Sterile	555	37.7	35.2–40.2
Non-sterile	569	38.7	36.2–41.1
<i>Hours per day wearing gloves</i>			
Sterile	1.5		
Non-sterile	1.6		
<i>No. of glove changes per day</i>			
Sterile	3.7		
Non-sterile	5.7		
<i>History of allergic disease</i>			
Allergic rhinitis	414	28.1	25.8–30.4
Eczema	307	20.9	18.8–22.6
Asthma	61	4.1	3.1–5.2
Hand dermatitis	255	17.3	15.4–19.3
Food allergy	229	15.6	13.7–17.4
Shellfish	209	14.2	12.4–16.0
Banana	15	1.0	0.5–1.5
Nuts	8	0.5	0.1–1.0
Avocado	2	0.1	0.0–0.5

Glove-related symptoms were common and 455 (30.9%) reported at least one symptom, the majority of which could be classified as GD. The mean time of onset from glove exposure to GD was 2.6–6.8 h. On the other hand, symptoms suggestive of LA were encountered less frequently and were noted in 3.3% of subjects. Amongst these subjects, one developed asthma and two had wheezing attacks after glove exposure, but there was no report of anaphylaxis. In a working day, compared to asymptomatic subjects, those

with GD and LA spent more hours wearing gloves (2.7 h vs 0.8 h for GD, 2.8 h vs 1.4 h for LA) and changed gloves more times (6.5 vs 2.4 for GD, 6.8 vs 3.5 for LA). Allergic symptoms related to other latex devices were less common, with exposure to rubber bands, rubber boots, goggles and swimming caps accounting for the majority of reactions (Table 3). There was no association between reported allergic reactions to tyres and a history of asthma or glove-related symptoms. However, of the 15 subjects with

Table 3. Reported symptoms related to latex gloves and other latex devices

	Number	%	95% confidence intervals
<i>Symptoms related to latex glove</i>			
Dryness	356	24.2	22.0–26.4
Pruritus	276	18.8	16.8–20.7
Redness	121	8.2	6.8–9.6
Eczema	53	3.6	2.6–4.6
Urticaria	30	2.0	1.3–2.8
Runny nose	18	1.2	0.7–1.8
Wheeze	2	0.2	0.0–0.5
Breathing difficulties	1	0.1	0.0–0.4
Asthma	1	0.1	0.0–0.4
Glove dermatitis	450	30.6	28.2–32.9
Latex allergy	49	3.3	2.4–4.2
<i>Symptoms related to other latex devices</i>			
Rubber band	61	4.1	3.1–5.2
Rubber boot	27	1.8	1.1–2.5
Swimming goggles	21	1.5	0.8–2.0
Swimcap	18	1.2	0.7–1.8
Hotwater bottles	9	0.6	0.3–1.2
Condom	6	0.4	0.2–0.9
Tyre	4	0.3	0.1–0.7
Wetsuit	2	0.1	0.0–0.5
Diaphragm	2	0.1	0.0–0.5
≥1 of above	145	9.9	8.3–11.4

banana allergy on history, 10 reported glove-related symptoms.

A total of 133 respondents underwent skin prick test and the results are shown in Table 4. Nine (6.8%) of these subjects had a positive skin test response to one or more of the glove extracts. All were atopic and reacted to at least one other common allergen, but none reacted to more than one glove extract. Of the nine subjects with positive latex skin test, five had a history of GD and the two with a history of LA also reported a history of GD. All but one of the positive skin reactions to latex were directed to disposable gloves. Table 5 shows the latex skin test response in subjects with and without symptoms. Those with LA were more likely to have a positive latex skin test than those with GD, which in turn, had a higher prevalence of skin test positivity to latex than asymptomatic subjects, although the differences between the three groups were not statistically significant. The sensitivity and specificity for a positive skin test response to latex were 55.6% and 65.3% respectively, given a history of GD, and were 22.2% and 96.8% for a history of LA. Three of the nine subjects with positive latex skin test had positive skin test to banana, whilst three out of

eight subjects with positive banana skin test were also skin test positive to latex extracts, suggesting a positive correlation ($P < 0.05$). The prevalence rates of positive skin test responses to inhalant allergens in our subjects were in keeping with previous epidemiological data [11].

Table 6 shows the selected risk factors for GD and LA. Daily glove use and a personal history of allergic disease were strong risk factors for both GD and LA. Whilst the association was stronger between daily glove use and GD (OR=16.90, 95% CI 12.00–23.80) than between daily glove use and latex dermatitis (OR=5.55, 95% CI 2.48–12.44), the reverse was true for the relationship of history of allergic disease with GD and LA. Skin test positivity to one or more latex glove extracts was a strong predictor of LA (OR=8.57, 95% CI 1.33–55.09) but not GD. On the other hand, nurses as a group were at a higher risk than other hospital employees of symptoms of GD (OR = 2.02, 95% CI 1.53–2.66) but not LA. Atopic status was not found to be a risk factor for either GD or LA. Both the duration of time exposed to latex gloves and the number of glove changes in a day were positively correlated with GD as well as LA ($P < 0.001$). In a multiple logistic regression model incorporating all the

Table 4. Skin test response

	Number	%	95% confidence intervals
Total	133		
Glove A	4	3.0	1.0–8.0
Glove B	2	1.5	0.3–5.9
Glove C	1	0.8	0.0–4.7
Glove D	1	0.8	0.0–4.7
Glove E	1	0.8	0.0–4.7
	9	6.8	3.3–12.8
<i>D. pteroyrnssinus</i>	59	44.4	35.9–52.8
<i>D. farinae</i>	41	30.8	23.0–38.7
Cockroach mix	36	27.1	19.5–34.6
Cat dander	10	7.5	3.0–12.0
Cladosporium	8	6.0	2.8–11.9
Penicillium	3	2.3	0.6–7.0
Aspergillus	1	0.8	0.0–4.7
Bermuda	9	6.8	3.3–12.8
Ragweed	3	2.3	0.6–7.0
Banana	6	4.5	1.8–10.0
Nuts	2	1.5	0.3–5.9
Avocado	0	0.0	—
Atopy	71	53.4	44.9–61.9

risk factors listed in Table 5, the remaining significant associations were between history of daily glove use and GD (OR = 50.11, 95% CI 15.88–158.13), and between positive latex skin test and LA (OR = 8.14, 95% CI 1.27–52.36).

Discussion

With the emergence of the acquired immunodeficiency syndrome epidemic and the practice of protecting healthcare

workers from all body fluids, the use of rubber gloves has increased worldwide, as has occupational allergy to latex amongst healthcare workers. In this paper, we report the prevalence of LA amongst hospital employees in a teaching hospital in Hong Kong, which is the first documentation of the epidemiology of LA in Asian populations. Our results show that whilst the prevalence of GD was high, the prevalence of LA of 3.3% was low compared to that of 5–10% in Western populations. However, the prevalence of skin test positivity to latex extracts of 6.8% is comparable to

Table 5. Skin test response to latex in healthcare workers with GD, LA and without symptoms

	GD (<i>n</i> = 48)		LA (<i>n</i> = 6)		Asymptomatic (<i>n</i> = 85)	
	No.	%	No.	%	No.	%
Total	48		6		85	
Glove A	3	6.3	1	16.7	1	1.2
Glove B	0	—	0	—	2	2.4
Glove C	0	—	0	—	1	1.2
Glove D	1	2.1	1	16.7	0	—
Glove E	1	2.1	0	—	0	—
Total	5	10.4	2	33.3	4	4.7

Table 6. Risk factors for GD and LA by univariate logistic regression. Values are odds ratios and 95% confidence intervals

	Glove dermatitis		Latex allergy	
	OR	95% CI	OR	95% CI
History of daily glove use at work	16.9	12.00–23.80	5.55	2.48–12.44
History of allergic disease				
Allergic rhinitis	1.29	1.01–1.64	4.29	1.79–2.88
Eczema	1.81	1.39–2.35	3.25	1.83–5.80
Asthma	1.30	0.76–2.21	3.47	1.42–8.50
Hand dermatitis	1.92	1.45–2.53	2.91	1.60–5.28
≥1 of the above	1.62	1.29–2.02	5.96	2.77–12.80
History of allergic symptoms to ≥1 non-glove latex devices	3.73	2.63–5.31	3.95	2.07–7.52
Atopy	1.05	0.52–2.14	1.79	0.32–10.13
Positive skin test to ≥1 glove extracts	2.35	0.60–9.23	8.57	1.33–55.09
Occupation as nurses	2.02	1.53–2.66	1.59	0.76–3.33
Working in wards	1.02	0.81–1.28	0.76	0.43–1.35
Exposure time	$P < 0.001$		$P < 0.001$	
Glove changes	$P < 0.001$		$P < 0.001$	

reports of 2.6% [12] to 10.7% [6] from Western populations. The antigenic proteins of latex are distributed unevenly on the glove surface and their concentrations differ amongst various brands of gloves [9].

It is a common practice in many hospitals in Hong Kong, as well as in China where the majority of gloves in our hospital are made, to re-use sterile latex gloves by autoclaving. The process of repeated washing, autoclaving and re-sterilization is likely to remove significant quantities of latex antigens from the gloves, thereby reducing their allergenic potentials, which may explain the low number of allergic reactions to sterile gloves compared to disposable gloves in our study. To the best of our knowledge, there has not been quantitative determination of latex allergens in the gloves used in our hospital and in the current study. It is possible that the gloved healthcare workers in Hong Kong are exposed to relatively low quantities of latex allergens from rubber gloves, which though they are sufficient to cause sensitization in predisposed individuals, are weak and inadequate triggers of acute allergic manifestations in the majority of latex-sensitive subjects.

The dose–response relationships between exposure, sensitization and allergic manifestations for latex allergens have not been fully established. Our findings of the positive correlations between LA and glove exposure time and number of glove changes add to the understanding of the natural history of latex allergy amongst healthcare workers. We found that subjects with positive latex skin test were 8.6 times more likely to report symptoms of LA than those with negative skin test, and this relationship remained significant in a multiple logistic regression model, although the odds

were slightly reduced to 8.1. Moneret-Vautrin tested 907 healthcare workers and all of the 18 who reported latex allergy symptoms had positive skin tests to latex extracts, whilst only six of the remaining workers with negative histories were skin test positive to latex [12]. Although all our subjects with positive latex skin tests were atopic to common allergens, we did not find any relationship between atopic status and symptoms of LA.

It seems that atopic subjects are more prone to become sensitized to latex allergens, and the presence of latex-specific IgE precedes the development of clinical manifestations which require repeated latex exposure [4]. Once symptoms have occurred, there is often a progression from cutaneous reactions to rhinoconjunctivitis to bronchospasm and anaphylaxis. It is therefore important to identify those high risk subjects who have already been sensitized but may or may not have current symptoms so that appropriate avoidance measures can be implemented to prevent the development or worsening of allergic manifestations. The use of hypoallergenic gloves with a lower protein content has recently been shown to be an effective avoidance measure to reduce the risk of asthmatic reactions in healthcare workers with latex-induced asthma when complete avoidance cannot be achieved [13].

We found that a history of allergic symptoms to a variety of devices containing latex is a strong risk factors for GD/LA. Proper latex avoidance practice should apply to the use of such devices in sensitive individuals as well. Besides dermatomucosal contact, airborne exposure to latex allergens adsorbed onto glove powder has been reported to cause acute asthma [14]. There is also evidence

to indicate that latex allergens on rubber tyre fragments of respirable sizes are present in abundance in urban air [15]. Four of our subjects reported allergic symptoms upon contact with tyres, and the lack of association with reported asthma and glove-related symptoms may be due to the small number of subjects. Whether airborne latex allergens contribute to respiratory allergies at a population level is unclear but certainly deserves further investigation.

In our study, we separated glove-related symptoms into GD and true LA, and the prevalence of GD was 30.4% and nurses were most at risk. Symptoms of GD such as dryness and itching are often due to irritation by or delayed hypersensitivity to rubber chemicals, and we showed that long glove exposure time predisposed to the occurrence of GD. The definition of GD and LA in our study was arbitrary and the two conditions indeed co-existed in a few subjects. Using similar definitions, Katelaris found a GD prevalence of 16% in 494 dentists [16] and 22% in 178 staff members of a dental school in Australia [17]. In the study of 268 operating room nurses by Lagier *et al.*, 40% reported hand symptoms associated with glove wearing but itching without urticaria was found to correlate poorly with latex sensitivity on skin testing [6]. These findings were consistent with our results which showed only moderate sensitivity and specificity for a history of GD to predict positive latex skin test. On the other hand, a history of LA was highly specific for latex sensitization and could be useful in screening healthcare workers at risk.

Cross-reactivity between latex allergens and banana [18], chestnuts [19] and avocado [20] has been reported, suggesting the existence of common epitopes. However, specific IgE to latex may be absent in those who have type I hypersensitivity to these foods [18]. Our results also demonstrated a significant correlation between sensitization to latex and banana. Similar associations could not be found for nuts and avocado because of the small number of subjects undergoing skin testing.

Our response rate of 73.6% for the questionnaire survey was acceptable but our skin test data could have suffered a degree of selection bias as only 133 out of 1472 respondents underwent skin testing. Nevertheless, the prevalence rates of skin test positivity to common allergens and the overall atopy rate were in keeping with previous data in the region [10]. We did not perform RAST to detect latex specific IgE as it has been found to be less specific than skin prick test in some reports [4]. Formal challenge with latex gloves is a helpful confirmatory test in individual case studies [21], but it is labour-intensive and becomes expensive and impractical in population studies.

We found a high prevalence of glove-related symptoms amongst hospital employees in Hong Kong. Atopic individuals are at risk of becoming sensitized to latex and those

with positive latex skin tests, long glove exposure time and frequent glove changes are at risk of clinical latex allergy. Symptomatic workers should be given appropriate avoidance advice.

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