ORIGINAL ARTICLE

Latex Allergen Sensitization and Risk Factors Due to Glove Use by Health Care Workers at Public Health Units in Florianopolis, Brazil

ZS Buss, TS Fröde

Department of Clinical Analysis, Center of Health Sciences, Federal University of Santa Catarina, Campus Universitário – Trindade, Florianopolis, SC, Brazil.

Abstract

Background: Natural rubber latex allergy is a "new" illness whose prevalence has reached epidemic proportions in highly exposed populations such as health care professionals.

Objective: The aim of the study was to evaluate the frequency of reactions to latex and risk factors due to glove use in health care workers (HCW) in Florianopolis, Santa Catarina, Brazil.

Methods: We evaluated latex-related allergy in 260 HCW by means of a questionnaire, skin prick tests (SPT) and serum latex specific IgE antibody levels. The subjects were divided into two groups depending on level of exposure to latex gloves. Comparisons were made between the different variables and a risk score was calculated using logistic regression analysis.

Results: Glove-related symptoms were observed in 57% of 140 HCW. Significant differences between HCW and control groups were found for the following symptoms: contact dermatitis ($P < .0001$), cutaneous rash ($P < .0001$), asthma or allergic rhinitis ($P < .0001$), symptoms associated with toy balloons ($P < .0001$), airborne glove powder causing latex allergen reaction ($P < .0001$), food allergy ($P < .0001$), fruit allergy ($P < .0001$) and multiple surgical interventions ($P = .0052$). Contact dermatitis and anaphylaxis were the main problems, with a high risk factor for the development of latex allergy. Logistic regression analysis showed a significant positive association between the risk of latex allergy and those subjects who reported more than 4 positive answers on the questionnaire (including SPT) (odds ratio 6.8; 95% confidence interval 0.7-60.3). No latex-related allergy symptoms were reported by the control group. Serological latex specific immunoglobulin (Ig) E antibody levels were negative for both groups.

Conclusion: It is essential to recognize which professionals are sensitized to latex in order to provide appropriate treatment and to establish adequate prevention.

Key words: Latex allergy. Health care workers. Skin prick test. Latex IgE antibody levels.

Resumen

Introducción: Se considera la alergia al látex como una enfermedad ocupacional importante entre profesionales del área de la salud.

Objetivo: el objetivo de este trabajo fue evaluar las reacciones alérgicas al látex, así como también evidenciar los factores de riesgo asociados al uso de guantes en funcionarios de Unidades Públicas de Salud en Florianópolis, Santa Catarina, Brasil.

Metodología: En este estudio se evaluó la alergia al látex en 260 funcionarios del área de la salud por medio de un cuestionario, pruebas cutáneas y dosificaciones séricas de IgE específica para el látex. Se dividió a los funcionarios en dos grupos de estudio, dependiendo del nivel de exposición al látex. Para evaluar las diferencias estadísticas de las variables entre los grupos de estudio se utilizó análisis estadístico de regresión logística.

Resultados: Se observaron síntomas de alergia al látex en 80 (57%) de los usuarios de guantes. En los cuestionarios analizados se verificaron diferencias estadísticas entre usuarios de guantes y grupo control para los siguientes síntomas: dermatitis de contacto ($P < 0,001$), rash cutáneo en las manos, ($P < 0,001$), asma o rinitis alérgica ($P < 0,001$), síntomas al llenar globo de aire ($P < 0,001$), síntomas respiratorios relacionados al polvo de los guantes ($P < 0,001$), alergia a alimentos ($P < 0,001$), alergia a las frutas ($P < 0,01$) e

historia de múltiples procedimientos quirúrgicos (P = 0,0052). Dermatitis de contacto y anafilaxia fueron los principales problemas, con alto riesgo de desarrollo de alergia al látex. A partir del análisis estadístico de regresión logística, se estableció una asociación significativa entre el riesgo de síntomas de alergia al látex, incluyendo la prueba cutánea positiva al látex y más de cuatro respuestas positivas relatadas en la entrevista, para los funcionarios usuarios de guantes (*odds ratio* = 6,8, LC 95%: 0,7 – 60,3). En el grupo control no se relataron de síntomas de alergia relacionados al látex. Las dosificaciones serológicas para IgE específica para el látex fueron negativas en ambos grupos de estudio.

Conclusión: La identificación de profesionales sensibles al látex es esencial para que se establezcan acciones profilácticas, así como tratamiento apropiado.

Palabras clave: Alergia al látex. Profesionales del área de la salud. Pruebas cutáneas. Dosificaciones séricas de IgE específica para el látex.

Introduction

Natural rubber latex (NRL) allergy is a "new" illness whose prevalence has reached epidemic proportions in highly exposed populations over the last decade [1, 2]. The main source of allergic exposure is the use of powdered latex gloves and the sensitivity is caused by the water-soluble proteins present in these products [3].

This disease has increased since the mid-1980s, especially in health care workers (HCW) exposed to NRL allergens [1, 2]. In 1987, because of acquired immunodeficiency syndrome, the use of gloves increased worldwide and consequently so did the number of occupational latex allergy cases among health care workers. The impact of latex allergy on the HCW population has been well documented, with prevalence estimates for latex glove allergy ranging from 3.3% in Japan [4], 13.6% in Jordan [5], 0.9% to 17% in Europe [6-10], 0.7% in Canada [11], 2.9 to 30% in the USA [12,13], 4% in Mexico [14], 17.3% in Argentina [15], and 6% to 8% in Brazil [16 , 17].

The prevalence of latex allergy in health care settings is reported to be affected by several factors, including atopy, frequency of glove use, prior or current hand dermatitis, and the length of time of hospital work is performed [3, 18]. Although atopy and frequent exposure to latex are considered to be independent risk factors for sensitization, exposure to latex is known to cause type IV hypersensitivity with an array of symptoms including pruritis, dermatitis, erythema and urticaria [19, 20]. Local and severe systemic immediate-type reactions such as anaphylaxis are rare, but their occurrence is certainly possible and this is particularly important in the health care sector [19, 20].

The problem of latex allergy is made even more complex by the presence of cross reactions with a large number of fruits and vegetables (e g, avocado, banana, kiwi, papaya, tomato, sweet pepper, and chestnut) [21, 22].

The diagnosis of latex allergy begins with a clinical history linking latex exposure and symptoms of the allergy. A suggestive history is then supported by confirmatory skin and serologic test responses for latex specific immunoglobulin E (IgE) antibody levels [19, 23-25]. The specific IgE antibody assay for latex is useful but not sufficient to establish the diagnosis [24, 25].

A large body of work on latex allergy has been reported in the past year, demonstrating the impact of containment strategies on exposure to latex and the incidence of sensitization to this allergen. Furthermore, occupational allergy is an important clinical and socioeconomic problem [26]. It is essential to recognize which patients and professionals are sensitized to latex to provide appropriate treatment and to establish adequate prevention.

In this context, the aim of our study was to evaluate the frequency of reactions to latex and risk factors due to glove use in workers in public health units in Florianopolis, Santa Catarina, Brazil. We also investigated the association between latex-related symptoms, in vivo and in vitro tests.

Methods

This cross-sectional study was carried out in 23 public health units in Florianopolis, Santa Catarina, Brazil. The study was conducted from May 2004 to April 2005. The groups studied included 260 workers who were divided into two groups: health care workers (nurses, pharmacists, physicians, dentists and laboratory assistants) who had frequent contact with gloves and/or latex products, and a control group (administrative directors, accountants, financial directors, and administrative assistants) who did not have frequent contact with gloves and/or latex products. All subjects gave written informed consent prior to participation and the study was approved by the Committee on Medical Ethics of the Federal University of Santa Catarina. The study was carried out in accordance with the regulations and recommendations of the Declaration of Helsinki.

The following exclusion criteria were used for all subjects: not having received ß-blockers, antihistamines, tricyclic antidepressants and corticosteroids up to 3 weeks before the study, and women who were pregnant or breast-feeding.

To evaluate latex allergy, a screening questionnaire designed to obtain sociodemographic, qualitative and quantitative data regarding past and current health status, latex exposure and allergic respiratory and/or dermatological disorders was distributed to both groups. Sociodemographic data were checked to characterize the study population and to investigate the risk factors and clinical complaints. Questions included sex,

Table 1. Demographic Characteristics of the Studied Subjects*

	Health Care Workers		Control Group		Total	
Subjects, n (%)	140	(54%)	120	(46%)	260	(100%)
Age, ± SE	38.8 ± 0.7		38.4 ± 0.9		38.6 ± 0.6	
Sex, n (%)						
Female	125	(89%)	15	(11%)	82	(68%)
Male	38	(32%)	207	(80%)	53	(20%)
Age groups, y						
≤ 25	10	(7%)	15	(12.5%)	25	(10%)
26 - 30	16	(11%)	14	(12%)	30	(11%)
31 – 35	15	(11%)	14	(12%)	29	(11%)
36 – 40	25	(18%)	21	(17.5%)	46	(18%)
41 – 45	39	(28%)	28	(23%)	67	(26%)
> 45	35	(25%)	28	(23%)	63	(24%)

* Data are number (%) or mean ± SE

age, frequency of latex glove use, exposure (hours of glove use per day), and information about family and personal histories of allergic disorders including asthma or rhinitis, allergies to foods and/or fruits, contact dermatitis, cutaneous rash, contact urticaria, multiple surgical interventions, and one or more of the following symptoms: 1) sneezing and rhinorrhea associated with airborne glove powder containing latex allergen or with toy balloons and 2) other immediate systemic ocular, nasal, or pulmonary complaints, and itching and/or redness associated with *i*) use of condoms containing latex, *ii*) direct mucosal and parenteral exposure to latex during medical procedures (pelvic or oral exam, for example) or *iii*) use of utensils with latex. We also investigated those individuals that had an anaphylactic reaction during surgical procedures.

All subjects were interviewed by a trained MSc degree student.

Skin testing

The skin prick tests (SPT) in both groups were performed with disposable sterile punctures in the volar region of the forearm with latex antigen containing 2 mg of latex mix (Allergofar, Brazil). Histamine at 10 mg/mL (Allergofar, Brazil) was also used as a positive control, and a sterile saline solution (NaCl 0.95%), was used as a negative control. The test was considered positive if after 15 minutes wheal size exceeded 3 mm.

Procedures

All laboratory specimens for this study were collected at the time the individuals came to the clinical laboratory for other reasons. Blood samples were drawn from the antecubital vein in the fasting state from the HCW group who gave positive to latex in the skin prick test. Silicone-coated tubes were used for latex specific immunoglobulin (Ig) E analysis. After being centrifuged, coded serum aliquots were stored at –20ºC and analyzed for latex-IgE antibody levels in a single batch at the end of the study. The samples from the control group were submitted to the same procedures.

Measurement of latex specific IgE antibody levels

The specific IgE determination was performed in both groups using the Pharmacia CAP System (Pharmacia Diagnostics AB, Uppsala, Sweden). Values greater than 0.35 kU/L were regarded as positive. The inter-assay coefficient of variation was 7.3% ± 0.9%, with a sensitivity of 0.35 kU/L.

Statistical Analysis

Continuous data are presented as mean ± standard error (SE) and percentages. The comparisons between means and percentages were performed using Student's t tests and χ^2 tests, respectively.

To analyze the association among risk factors reported in the questionnaire by HCW, we used the odds ratios (OR) with 95% confidence intervals (CI). In the 2×2 contingency table when the counts were 0 in any cell, Fisher's exact test was used instead of OR to evaluate the association.

A risk score was created from the responses to the latex allergy items reported in the questionnaire and the positive prick tests in HCW. This risk score was used as one of the predictors of latex allergy by logistic regression analysis performed with Stata/SE 9.0 software. Various cut off points were analyzed. The level of statistical significance for type I error (α) was set at $P < .05$.

Results

Of the 260 subjects studied, 207 (80%) were female and 53 (20%) were male. The mean ± SE. age of all subjects was 38.6 ± 0.6 years (Table 1). In the HCW, we studied 140 subjects (54%

Table 2. Demographic Characteristics of Health Care Workers With Symptoms Related to Latex Allergy and the Frequency of Latex Glove Use.

Characteristics	Latex symptoms n = 80	(57%)	*P*
Age group (n) [years]			
≤ 25 (10)	4	(40%)	*P* < .01
26 - 30 (16)	9	(56%)	
31 – 35 (15)	7	(46%)	
36 – 40 (25)	13	(56%)	
41 – 45 (39)	21	(54%)	
> 45 (35)	26	(74%)	
Latex glove use (n)			
1-3 h/d (59)	24	(40%)	*P* < .01
3-5 h/d (43)	25	(58%)	
6h/d (38)	31	(81%)	

of the total), 125 females (89%) and 15 males (11%), with a mean age of 38.8 ± 0.7 years (Table 1). In the control group, we analyzed 120 subjects (46% of the total), 82 females (68%) and 38 males (32%), with a mean age of 38.4 ± 0.9 years (Table 1).

Latex allergy symptoms were present in 80 individuals (57%) in the HCW group (Table 2). Twenty-six of the HCW (74%) over 45 years old reported latex-related symptoms in comparison to 54 individuals who were under 45 years old and of whom 40% to 56% reported the same symptoms (*P* < .01) (Table 2). Another important finding was that 31 (81%) of the over 45 year old group used gloves more than 6 hours per day in comparison to 25 (58%) who used gloves 3 to 5 hours per day or 24 (40%) who used gloves 1 to 3 hours per day (Table 2).

There was a significant difference in the latex allergy symptoms reported from the questionnaire between the HCW and control group. The major symptom observed in HCW was contact dermatitis in 80 of the 140 subjects (57%) studied (*P* < .0001) (Table 3). Sixty-seven members of this group (52%) also reported cutaneous rash symptoms. The OR for this complaint was 10.0, (95% CI, 4.8-20.9; *P*<.0001) (Table 3). Symptoms of asthma or allergic rhinitis, whether associated or not with toy balloons, were also observed in 61 (43%) of the HCW group. The ORs were 3.4, (95% CI, 1.9-6.1; *P* < .0001) for asthma and rhinitis symptoms, and 8.5, (95% CI, 4.1-17.6; *P* < .0001) for oral itching and/or redness symptoms associated with toy balloons (Table 3). Similarly, 49 (35%) of the latex exposed workers suffered from sneezing and/or rhinorrhea symptoms involving airborne glove powder (OR, 10.2; 95% CI, 4.1-24.9; *P* < .0001) (Table 3). Following this, in relation to allergy to ingested certain foods, 35 subjects (23%) from the HCW group described symptoms of fruit allergy (OR, 11.5; 95% CI, 3.4-38.8; *P* < .0001) and 35 (25%) reported symptoms of allergy to other kinds of foods (OR, 6.3; 95% CI, 2.5-15.7; *P* < .0001) (Table 3). Histories of multiple surgical interventions or invasive procedures were also detected in 32 individuals (23%). The OR and 95% CL found in this group was 2.9, (95% CI, 1.4-6.1; *P* = .0052) (Table 3). It is also important to note that 26 subjects (18%) reported itching and/or redness symptoms after the use of condoms containing latex (OR, 3.2; 95% CI, 1.4-7.3; *P* = .008) (Table 3). One of the minor prevalences (16, 11%) of these latex allergy symptoms reported by HCW was itching and/or redness after medical procedures (pelvic or oral exam) (OR, 12.2; 95% CI, 1.4-17.7; *P* = .0118). Thirteen HCW (9%) reported a severe systemic allergic response characterized by hypotension and bronchospasm during surgical procedures (Table 3). It is important to note that this symptom was the second most important risk factor for the development of latex allergy (OR, 12.2; 95% CI, 1.6-94.6; *P* = .0062) (Table 3).

There were no significant statistical differences in relation to the following claims: itching and/or redness symptoms after use of utensils with latex (*P* = .3293) and contact urticaria-related symptoms (*P* = .3028) (results not shown).

No latex-related allergy symptoms mentioned in the questionnaire were reported by the control group.

The in vivo test was also applied in both groups. Six members of the HCW group (4%) showed a positive skin prick test (SPT) reaction with a mean wheal diameter of 3.3 ± 0.03 mm. The mean age of this group was 45.8 ± 1.9 years. This group was composed of 5 females (3.3%) and 1 male (0.7%) (results not shown). We observed a statistically significant difference between HCW and the control group in relation to the SPT (*P* = .0322). The control group showed a negative SPT (results not shown).

Logistic regression analysis was also applied to evaluate the influence of potential risk factors for latex allergy from the allergic symptoms reported by HCW. We found a significant association between the risk of latex allergy symptoms, including a positive SPT, and more than four positive answers on the questionnaire for the HCW population (OR, 6.8; 95% CI, 0.7-60.3) (results not shown). Our results also demonstrated that in this group, 100% of those who had a positive SPT reported contact dermatitis and cutaneous rash. Five individuals (83%) reported allergies to fruits and other foods. Four (66%) complained of sneezing, rhinorrhea, itching and/or redness symptoms associated with toy balloons. Three subjects (50%) had asthma or rhinitis, 2 individuals (33%) reported allergic symptoms such as sneezing or rhinorrhea associated with airborne glove powder, itching and/or redness after the use of condoms. One subject (16%) reported local itching or redness after the use of utensils with latex (Table 4).

Finally, the in vitro test showed that the mean of the latex specific IgE antibody levels in the HCW (n = 6) who showed positive in skin prick test was less than 0.35 ± 0 kU/L. None of the sera belonging to the healthy control group showed the presence of latex specific IgE antibody levels.

Discussion

Skin and respiratory allergies are well known occupational problems for health care workers [1, 4, 7, 11, 27] and the use of powdered latex gloves has been identified as a major source of the problem. As was noted above, studies have demonstrated that the prevalence of latex allergy in the health care workers varies considerably.

In our study, we confirmed a significant association between latex-related symptoms and the employment seniority (over 45 years of age) of HCW (74%) (Table 2). The explanation

Table 3. Clinical Symptoms Associated With Latex Allergy in Health Care Workers*

Symptoms	No	(%)	OR	95% CI	*P*
Contact Dermatitis	80	(57%)‡	NA	NA	*P* < .0001
Cutaneous rash	67	(52%)‡	10.0	4.8-20.9	*P* < .0001
Asthma/ allergic rhinitis	61	(43%)‡	3.4	1.9-6.1	*P* < .0001
Symptoms associated with toy balloons	61	(43%)‡	8.5	4.1-17.6	*P* < .0001
Symptoms involving airborne glove powder	49	(35%)‡	10.2	4.1-24.9	*P* < .0001
Food Allergy	35	(25%)‡	6.3	2.5-15.7	*P* < .0001
- Fruit Allergy	32	(23%)‡	11.5	3.4-38.8	*P* < .0001
Multiple surgical interventions	32	(23%)†	2.9	1.4-6.1	*P* = .0052
Symptoms after use of condoms	26	(18%)†	3.2	1.4-7.3	*P* = .008
Symptoms after medical procedures (pelvic and/or oral exam)	16	(11%)†	5.0	1.4-17.7	*P* = .0118
Hypotension and bronchospasm during surgical procedures.	13	(9%)†	12.2	1.6-94.6	*P* = .0062

* OR indicates odds ratio; CI, confidence interval; NA, not applicable
†*P* < .05 and ‡ *P* < .01.

Table 4. Demographic Characteristics and Clinical Symptoms Reported by Health Care Workers With Positive Skin Prick Test*

Case	Age, y	Sex	Glove Exposure	Symptoms								
				1	2	3	4	5	6	7	8	9
1	50	F	≥ 6h/day	X	X	X	X	X	X	X		
2	41	F	≥ 6h/day	X	X	X	X				X	X
3	48	F	≥ 6h/day	X	X	X	X	X				
4	40	F	≥ 6h/day	X	X	X	X	X	X			
5	51	F	3-5 h/day	X	X					X		
6	45	M	≥ 6h/day	X	X	X					X	

* Symptoms: 1 indicates contact dermatitis; 2, cutaneous rash; 3, fruit and/or food allergy; 4, symptoms associated with toy balloons; 5, asthma/ rhinitis; 6, multiple surgical interventions; 7, symptoms (sneezing and/or rhinorrhea) itching and/or redness involving airborne glove powder; 8, symptoms (itching and/or redness) after use of condoms; 9, symptoms (itching and/or redness) after use of utensils with latex.
F indicates-female; M indicates male

for these results is that exposure to latex antigens occurs via direct contact with the skin's mucous membranes transported by protein particles that adhere to the powder of the gloves. Absorption of latex proteins through the skin is considered to be the main pathway of sensitization, and it is mainly responsible for local manifestations of urticaria that eventually may become systemic [19, 20]. These events associated with long term latex exposure (> 6 hours per day) may sensitize the individuals to the development of latex allergy.

Thus, our results provide clear evidence of an association between latex allergy and contact dermatitis and cutaneous rash symptoms, which affected 57% and 52% of the HCW, respectively. It is important to note that in our study contact dermatitis was considered the greatest risk factor for an individual to develop latex allergy. Furthermore, all HCW with positive SPTs reported this symptom. Our findings are very similar to those obtained by Clayton and Wilkinson [28] who also reported the incidence of hand dermatitis associated with the use of latex gloves. These authors found these symptoms to be present in 62% of 224 health care workers from the Department of Dermatology at the University of Leeds, United Kingdom.

Exposure to natural rubber latex proteins also occurs by ingestion of fruits or other foods. There are various reports of fruit intolerance to priory avocados, bananas, kiwis, chestnuts, melons and peaches [21, 29]. Our results showed that 23% of HCW had some kind of fruit allergy symptoms, and in the 5

HCW that had positive SPT results, 83% had food/fruit allergies. Blanco et al [29] found fruit allergies in 33% of 78 patients from the Dr Negrín Hospital, Canary Islands, Spain. In another study Brehler et al [21] reported that 32% of 136 subjects from the Department of Dermatology and Venereology at the University of Munster, Germany had latex allergic symptoms associated with latex fruit syndrome.

The inhalation of protein particles dispersed in the air is capable of triggering nasal, ocular, and respiratory symptoms [4]. Indeed, 43% of the HCW group reported asthma and rhinitis symptoms or a strong reaction associated with toy balloons or involving airborne glove powder. Of the 6 HCW who were SPT positive, 3 had asthma/rhinitis symptoms.

Data reported by Lopes et al [17] have also demonstrated a prevalence of 62.5% for the same respiratory symptoms described above in 96 health care workers in neonatal intensive care at the Women's Integral Healthcare Center, University of Campinas, São Paulo, Brazil. These findings imply that chronic inhalation of latex allergens could be an important risk factor for the development of latex hypersensitivity and the exacerbation of respiratory symptoms.

Other symptoms such as those reported by individuals who had had multiple surgical or medical procedures, itching and/or redness complaints after the use of condoms or latex utensils were also detected in the HCW. These symptoms were less frequent, but were also important. Chen et al [30] have also described a low prevalence (2.7%) of latex sensitization in obstetric patients that had regularly used condoms in the past.

Although an anaphylatic reaction during surgical procedures had occurred in less than 9% of the HCW group, this complaint was the second-most important risk factor for the development of latex allergy. It is obvious that these symptoms provide clear evidence of systemic reaction in an allergic disease [31].

In our study we observed a positive reaction in the skin prick test in 4% of the HCW group. Lopes et al [17] found an identical result in around 8% of the 96 health care workers they studied. Similar results have also been reported by Clayton and Wilkinson [28] who found 10% of 224 health care workers from the Department of Dermatology at the University of Leeds, United Kingdom to be SPT positive.

Our results showed no clear evidence for a relationship between latex antigen positivity for SPT and serum latex specific IgE antibody levels. A similar result was obtained by Lopes et al [17]. One of the hypotheses to explain this lack of association has been put forward by Hamilton et al [25] who showed that allergen skin testing provides higher sensitivity and specificity (94% and 98%, respectively) than does anti-latex IgE serologic testing (77% and 91%, respectively). Finally, it is important to comment that gloves represent an important risk factor for the development of latex allergy, because gloves can disperse latex antigens into the work environment [32]. The consequence is the inhalation of allergens dispersed into the air, which induces respiratory symptoms and local skin exposure leading to dermal reactions [20].

In conclusion, latex allergy represents an occupational disease. It is important to adopt preventive measures to protect all health care workers in order to identify subjects at risk, and consequently make sure that they adopt measures to prevent major problems. Furthermore, the risk of latex sensitization or latex allergy could be minimized by decreasing the amount of extractable proteins in latex products.

Acknowledgment

The authors wish to thank Emil Kupek (PhD) and Eliana Maria de Almeida (MSc) for providing excellent technical support during the study. This work was supported by "Pró-Extensão" at the Federal University of Santa Catarina (UFSC). Ziliani Buss is an MSc student.

References

1. Allmers H, Schmengler J, John SM. Decreasing incidence of occupational contact urticaria caused by natural rubber latex allergy in German health care workers. J Allergy Clin Immunol. 2004; 114:347-51.
2. Charous BL, Blanco C, Tarlo S, Hamilton RG, Baur X, Beezhold D, Sussman G, Yunginger JW. Natural rubber latex allergy after 12 years: Recommendations and perspectives. J Allergy Clin Immunol. 2002; 109:31-34.
3. Cullinan P, Brown R, Field A, Hourihanes J, Jones M, Kekwick R, Rycroft R, Stenz R, Williams S, Woodhouse C. Latex allergy. A position paper of the British Society of Allergy and Clinical Immunology. Clin Exp Allergy. 2003; 33:1484-99.
4. Kano H, Yagami A, Suzuki K, Akita H, Akamatsu H, Matsunaga K, Ongo Y. Survey of awareness and current state of latex allergy among all health care workers at a university hospital. Arerugi. 2004; 53:659-68.
5. Khader Y, Abu-Zaghlan M, Abu-Al Rish I, Burgan S, Amarin Z. Self-reported allergy to latex gloves among health care workers in Jordan. Contact dermatitis. 2005; 53:339-43.
6. Handfield-Jones SE. Latex allergy in health care workers in an English district general hospital. Br J Dermatol. 1998; 138:273-76.
7. Galobardes B, Quiliquini AM, Roux N, Taramarcaz P, Schira JC, Bernstein M, Morabia A. Influence of occupational exposure to latex on the prevalence of sensitization and allergy to latex in a Swiss hospital. Dermatology. 2001; 203:226-32.
8. Agarwal S, Gawkrodger DJ. Latex allergy: a health care problem of epidemic proportions. Eur J Dermatol. 2002; 12:311-15.
9. Esteve M, Casas I, Baltasar M, Rodriguez D, Casas X, Monso E. Prevalence of latex-related sensitization in health care workers. Med Clin. 2003; 121:681-83.
10. Proietti L, Gueli G, La Rocca G, Bonanno G, Vasta N, Bella R, Barbagallo S. Latex allergy prevalence and atopy in 1300 health care workers. Recenti Prog Med. 2005; 96:478-82.
11. Liss GM, Sussman GL. Latex sensitization: occupational versus general population prevalence rates. Am J Ind Med. 1999; 35:196-200.
12. Hunt LW, Fransway AF, Reed CE, Miller LK, Jones RT, Swarson MC, Yunginger JW. An epidemic of occupational allergy latex involving health care workers. J Occup Env Med. 1995; 37:1204-09.
13. Page EH, Esswein EJ, Petersen MR, Lewis DM, Bledsoe TA. Natural rubber latex: glove use, sensitization, and airborne and latent dust concentrations at a Denver hospital. J Occup Environ Med. 2000; 42:613-20.
14. Moreno HL, Avila E, Angulo Y, Portillo J, Moreno L, Reza G, Hernandez V, Levario M. Frequency in allergy to proteins of latex in health care workers. Allergol Immunopathol. 2005; 33:210-13.
15. Docena GH, Fernandez R, Ocampo M, Fossati CA. Serological

investigation of latex allergy in Argentina. Allergy and Asthma Proceedings. J Reg St Allergy Soc. 1999; 20:99-106.
16. Geller M, Paiva TCB, Geller P. Alergia ao látex mediada por IgE em Centro Cirúrgico. Rev Bras Alergia Imunopatol. 1997; 20:166-68.
17. Lopes RAM, Benatti MCC, Zollner RL. Occupational exposure of Brazilian neonatal intensive care workers to latex antigens. Allergy. 2004; 59:107-10.
18. Taylor JS, Wattanakrai P, Charous BL, Ownby DR. Year book focus: latex allergy. In BH Thiers, PG Lang, editors. The year book of dermatology and dermatology surgery. St. Louis: Mosby Inc; 1999. p. 325-68.
19. Taylor JS, Erkek E. Latex allergy: diagnosis and management. Dermatol Ther. 2004; 17:289-301.
20. Monduzzi G, Franco G. Practicing evidence-based occupational health in individual workers: how to deal with a latex allergy problem in a health care setting. Occup Med. 2005; 55:3-6.
21. Brehler R, Theissen U, Mohr C, Luger T. Latex-fruit syndrome: frequency of cross-reacting IgE antibodies. Allergy. 1997; 52:404-10.
22. Sicherer, S.H. Clinical implications of cross-reactive food allergens. J Allergy Clin Immunol 2001; 108:881-90.
23. Kurtz KM, Hamilton RG, Schaefer JA. Adkinson NF. A hooded exposure chamber method for semiquantitative latex aeroallergen challenge. J Allergy Clin Immunol. 2001; 107:178-84.
24. Hamilton RG. Diagnosis of natural rubber latex allergy. Methods. 2002; 27:22-31.
25. Hamilton RG, Peterson EL, Ownby DR. Clinical and laboratory-based methods in the diagnosis of natural rubber latex allergy. J Allergy Clin Immunol. 2002; 110:47-56.
26. Frew AJ. Advances in environmental and occupational disorders. J Allergy Clin Immunol. 2003; 111:824-28.
27. Tarlo SM, Easty A, Eubanks K, Parsons CR, Min F, Juvet S, Liss GM. Outcomes of a natural rubber latex control program in an Ontario teaching hospital. J Allergy Clin Immunol. 2001; 108:628-33.
28. Clayton TH, Wilkinson SM. Contact dermatoses in health care workers: reduction in type I latex allergy in a UK centre. Clin Exp Dermatol. 2005; 30:221-25.
29. Blanco C, Sánchez-García F, Torres-Galván MJ, Dumpierrez AG, Almeida L, Figueroa J, Ortega N, Castillo R, Gallego MD, Carrillo T. Genetic basis of the latex-fruit syndrome: Association with HLA class II alleles in a Spanish population. J Allergy Clin Immunol. 2004; 114:1070-76.
30. Chen FC, Von Dehn D, Buscher U, Dudenhausen JW, Niggemann B. Atopy, the use of condoms, and a history of cesarean delivery: potential predisposing factors for latex sensitization in pregnant women. Am J Obstet Gynecol 1999; 181:1461-64.
31. Haeberle HA, Midoro-Horiutu DLT, Kiefer RT, Schoeder TH, Unertl K, Dieterich HJ. Role of Cross-Allergies to Latex in Clinical Routine of Anesthesia. J Clin Anaesth. 2003; 15:495-504.
32. Mahler V, Fischer S, Fuchs T, Ghannadan M, Valent P, Fartasch M, Kraft D, Schuler G, Valenta R. Prevention of latex allergy by selection of low-allergen gloves. Clin Exp Allergy. 2000; 30:458-60.

Manuscrit received May 17, 2006; accepted for publication July 27, 2006

Tânia Silvia Fröde

Universidade Federal de Santa Catarina (UFSC),
Centro de Ciências da Saúde (CCS),
Departamento de Análises Clínicas (ACL),
Campus Universitário
Trindade, 88040-970, Florianópolis, SC, Brazil
E-mail: saleh@ccs.ufsc.br