Prevalence and Risk Factors for Latex-Related Diseases Among Healthcare Workers in an Italian General Hospital

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Abstract. Latex allergy has become an occupational hazard among healthcare workers. Atopy and degree of exposure have been recognized as predisposing factors for latex sensitization. We investigated the prevalence of latex allergy and the potential risk factors for latex sensitization, by distributing a questionnaire to 284 employees of a general hospital in central Italy. We collected information about occupational history, including specific tasks performed; time of first exposure to latex gloves; number of pairs of gloves; and duration of daily exposure. We also investigated the interval between first exposure and onset of symptoms, as well as the exact circumstances of their appearance. We evaluated pre-existing rhinoconjunctivitis, asthma, atopic and contact dermatitis, and allergies to drugs and foods using prick and patch tests. Latex allergy was established by means of skin-prick test, specific IgE, patch-test, and latex-glove-wearing test. This survey documented a high prevalence of symptoms related to the use of latex (47%) among the hospital staff; demonstrable sensitization to latex was considerably lower (12%), though strongly associated to atopy and duration of occupational exposure. Despite non-specificity, validated questionnaires constitute the most useful means to implement health surveillance and prevention of latex-related diseases among healthcare workers. *(received 15 January 2003; accepted 6 February 2003)*

Keywords: latex allergy; latex gloves; natural rubber latex; occupational health; atopy

Introduction

Allergic sensitization to natural rubber latex (NRL) has become an important occupational health problem among healthcare workers [1,2]. Proteins of NRL (hevamine, hevein, and rubber elongation factor) can be absorbed through the skin or inhaled, and cornstarch glove powder can act as a carrier for these allergenic proteins. Skin manifestations may include allergic contact dermatitis (type IV or delayed hypersensitivity), urticaria, and angioedema (IgE mediated, type I or immediate hypersensitivity reaction). Immediate hypersensitivity reactions to latex cause rhinitis, conjunctivitis, asthma, and in rare cases anaphylaxis [1].

Prevalence of latex allergy in the general population appears steady at <1% [3]. Prevalence studies have indicated that 5 to 15% of exposed healthcare workers are sensitized to NRL [4-7]. Some studies suggest that a low frequency of confirmed sensitization (3% prevalence) corresponds to a high frequency of symptoms reported by healthcare workers in survey questionnaires [8].

An apparent rise in incidence of latex-related symptoms has been associated with widespread use of NRL gloves to protect against blood-transmitted infections. Atopy and degree of exposure have been recognized as factors predisposing to latex sensitization in healthcare workers [9]. In many hospitals, latex-free routes have been realized to avoid

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the possible occurrence of severe reactions in workers and patients [10].

Data from several epidemiological studies show that sensitization varies among countries [3,5-7] and regions of the same country [11]. It is necessary to gather information about the frequency and determinants of latex sensitization so that preventive measures and health surveillance can be implemented effectively. With this in mind, we investigated the prevalence of latex sensitization and potential risk factors among healthcare personnel in a district general hospital in central Italy.

Methods

Subjects. We surveyed 284 employees of a General Hospital in Central Italy. The aim and procedures of the survey were presented to the local health and safety committee and to the hospital employees. The participants signed a statement of informed consent for each part of the study.

First step. A questionnaire was administered to 284 healthcare workers. Information about occupational history was obtained, including the specific tasks performed, department, time of first exposure, and duration of latex-exposure. The questionnaire also investigated the number of pairs of gloves used per day, the hours they were worn, and former exposures at risk of causing sensitization. Symptoms (urticaria, angioedema, isolated eyelid erythema and oedema, eczema, rhinoconjunctivitis, asthma, anaphylactic shock), time interval between the first exposure and the onset of symptoms, and circumstances of the appearance of symptoms were also reported.

Predisposing factors to sensitization were considered, as well as pre-existing rhinoconjunctivitis, asthma, atopic dermatitis, contact dermatitis, drug and food allergies (including oral allergic syndrome) or sensitization to cross-reacting foods (especially avocado, kiwi, banana, and chestnuts). In addition, a history of multiple surgical procedures, urogenital malformations, spina bifida, and any non-work-related exposures to other latex items (household cleaning gloves, diaphragm, condoms, etc) were also reported as potential predisposing factors.

Second step. Subjects were skin tested for the following substances:

- common inhalant extracts including timothy grass, parietaria, olea, alternaria, dust mite and food extracts including avocado, banana, kiwi, potato, chestnuts, and cow's milk,
- ammoniated latex extracts (protein concentration 12.5 ng/ml; Lofarma, Milan, Italy),
- cornstarch powder extract of products used in the hospital,
- Diluent as a negative control and histamine chlorhydrate (1 mg/ml) as a positive control.

A positive skin prick test was defined as a wheal diameter of 4 mm r ead after 15 min. Atopy was defined as the presence of a positive skin reaction to at least one of the tested inhalant and food allergens. Specific IgE to latex was measured by the CAP FEIA test (Pharmacia, Uppsala, Sweden)

Subjects who had reported in the questionnaire cutaneous symptoms suggestive of delayed type hypersensitivity were patch tested with an aqueous ammonia NRL extract (Lofarma). The patches were applied with Finn chambers in association with a standard series of antigens established by GIRDCA [12] including rubber chemicals (Lofarma). The exposure time was 2 days. A latex-glove-wearing test was then performed on all patients previously patch-tested.

Results

The total number of participants replying to the questionnaire was 197 (69.3%), including 140 (71%) nurses, 32 (16.3%) physicians, and 25 (12.7%) other occupations; age of responders ranged from 19 to 54 yr (mean 38 yr); 68% were women. Symptomatic subjects were 93 (47.2%). Skin-prick-test with latex extracts was positive in 24 subjects (12.1%) and latex specific IgE was detected in 20 (10.1%) who were all skin-test positive. Atopy was present in 67 subjects (34%), 20 of whom were sensitized to NRL, as shown by skin test positivity and a positive assay for specific IgE (Table 1). Twelve latex-prick-test positive subjects of the 67 atopics were also positive to latex cross-reacting food extracts (banana, kiwi, avocado, potato, and chestnuts).

Table 1. Skin-prick test (SPT) and specific IgE test to latex in the hospital staff. The percentages are related to the number of workers replying to the questionnaire. The percentage of positive SPT and specific IgE are also related [in square brackets] to the total number of distributed questionnaires.

Diagnostic test	Symptomatic Subjects			Asymptomatic subjects		
	Total	Atopics	Non-atopics	Total	Atopics	Non-atopics
Positive SPT	24 (12.1%) [8.5%]	20 (10.1%) [7.0%]	4 (2.0%) [1.4%]	0	0	0
Negative SPT	69 (35.0%)	19 (9.6%)	50 (25.4%)	104 (52.0%)	28 (14.2%)	76 (38.6%)
Positive specific IgE	20 (10.1%) [7.0%]	20 (20.1%) [7.0%]	0	0	0	0
Negative specific IgE	73 (37.1%)	19 (9.6%)	54 (27.4%)	104 (52.0%)	28 (14.2%)	76 (38.6%)

Table 2. Prevalence of work-related symptoms in patients with positive results for the natural rubber latex (NRL) skin-prick test (SPT), IgE, and patch tests (PT).

Symptom category	Symptom (n and % of total)	Latex SPT	Latex IgE	Latex PT	Rubber chemicals PT
Hand eczema	17 (37%)			6	3
Hand redness and itching	8 (17%)			0	0
Hand desquamative lesions	4 (9%)			0	0
Urticaria	8 (17%)	4 (33%)	3 (30%)		
Asthma	2 (4%)	2 (17%)	2 (20%)		
Angioedema	2 (4%)	1 (8%)	0		
Rhinoconjunctivitis	2 (4%)	2 (17%)	2 (20%)		
Rhinoconjunctivitis, asthma	3 (6%)	3 (25%)	3 (30%)		
Totals	93	24	20	6	3

Table 3. Prevalence of symptomatic workers and positivity of skin-prick test (SPT) and specific IgE (all IgE positives are also SPT positives) in relation to daily exposure time to latex and number of pairs of latex gloves uesd per day (* $p < 0.01$; ° $p < 0.001$).

Subject category	Daily exposure time		Glove pairs used per day	
	<3 hr	>3 hr	<3 pairs	>3 pairs
Surveyed workers (n = 197)	73 (37%)	124 (63%)	77 (39%)	120 (61%)
Asymptomatic workers (n = 104)	49 (47%)	55 (53%)	57 (55%)	47 (45%)
Symptomatic workers (n = 93)	24 (26%)	69 (74%)	20 (22%)*	73 (78%)*
Positive SPT (n = 24)	10 (42%)	14 (58%)	2 (8%)°	22 (92%)°
Positive specific IgE (n = 20)	12 (60%)	8 (40%)	0°	20 (100%)°

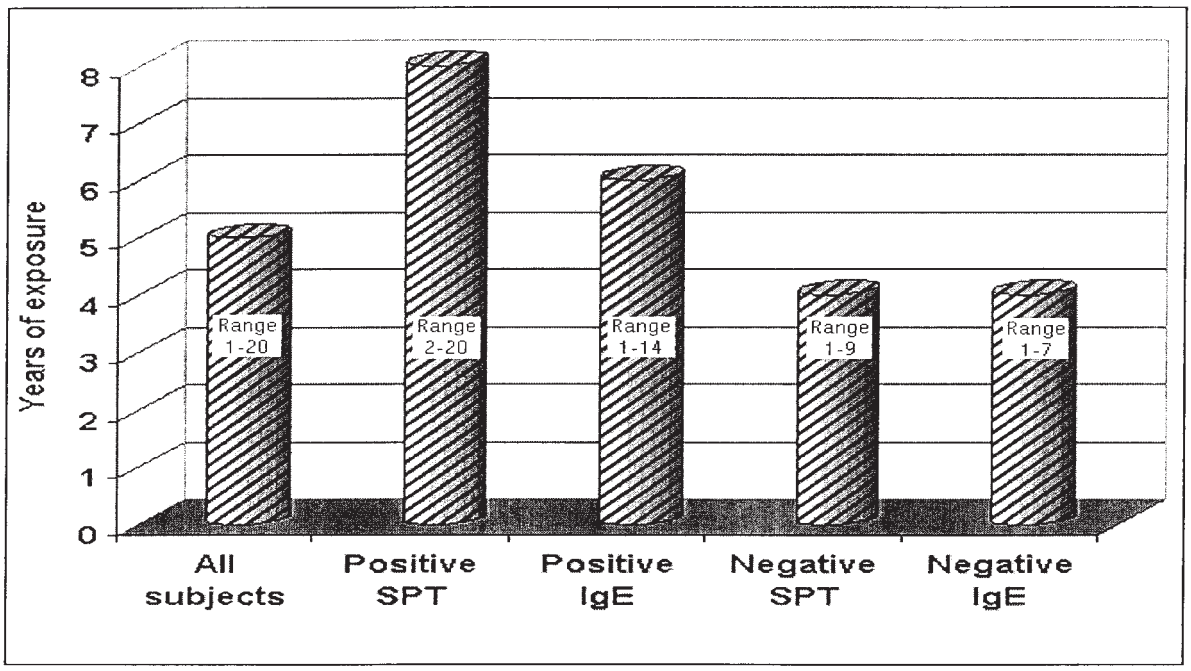

Fig. 1. Duration (yr) of occupational exposure to latex before onset of symptoms in allergic (positive skin-prick test [SPT] and/or specific immunoglobulin E [IgE])and non-allergic (negative SPE and/or specific IgE).

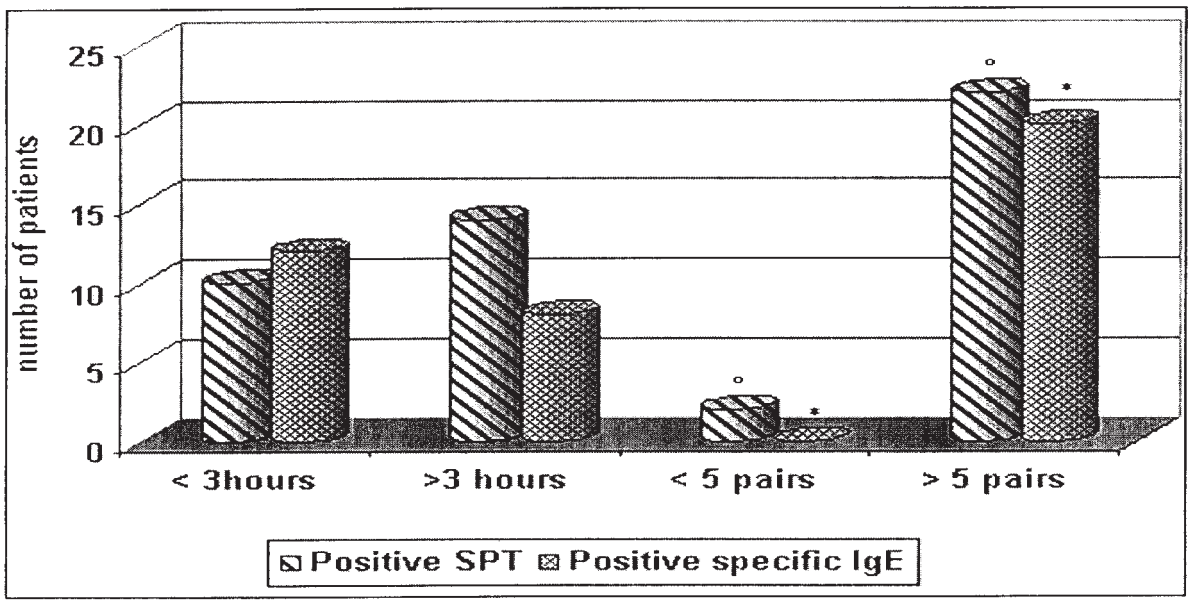

Fig. 2. Positivity of skin-prick test (SPT) and specific IgE in relation to daily exposure time (< 3 hr/day or >3 hr/day) to latex and number of latex gloves (<5 pairs or >5 pairs) used per day (* $p < 0.05$; • $p < 0.001$).

The time interval between the first exposure and the onset of symptoms was >5 yr (range 5–20 yr) in 53% of workers, 2–5 yr in 15%, 1–2 yr in 6%, and <1 yr in 26%. The duration of occupational exposure before onset of symptoms was higher in sensitized workers than in non-allergic but symptomatic participants (Fig. 1)

Table 2 shows the prevalence of work-related symptoms according to the presence of immediate hypersensitivity to latex (positive skin-prick test and/or CAP assay) or delayed hypersensitivity (type IV immune reaction detected by positive skin patch test). Latex-glove-wearing test was positive in 52 of 59 (88%) subjects who were previously patch-tested. Among the subjects surveyed, 37% had an average daily exposure to latex gloves of <3 hr/day, while the remaining 63% were exposed for 3 hr/day to a maximum of 10 hr/day; among them 61% used >5 pairs of latex gloves per workday.

Table 3 shows the prevalence of symptomatic workers and latex sensitization (positive SPT and specific IgE) in relation to daily latex exposure time and number of latex glove pairs used per workday. The percentage of symptomatic workers who used >5 pairs of latex gloves was significantly higher ($p < 0.01$) than those using <5. Almost all latex allergic (positive skin-prick test and/or specific IgE) workers used >5 pairs of latex gloves per day (Fig. 2)

The highest prevalence of symptomatic workers was found in the surgical operating rooms, followed by intensive care units, endoscopy units, and the emergency unit. Few cases were employed in internal medicine wards. Almost all sensitized (positive SPT and/or specific IgE) subjects worked in operating rooms or intensive care units (Table 4).

Table 4. Prevalence of symptomatic workers and latex allergy with positive SPT tests (with specific IgE positives noted in parentheses) in relation to occupation and workplace.

Category	All workers	Symptomatic	SPT positives
Operating rooms			
Nurse	42	38	14 (13)
Doctor	8	2	1
Others	8	2	
Intensive care units			
Nurse	33	25	7 (5)
Doctor	9	1	
Others	4	1	
Endoscopy unit			
Nurse	26	9	2 (1)
Doctor	5	1	
Others	7	3	
Emergency rooms			
Nurse	22	7	(1)
Doctor	4	1	
Others	4	1	
Internal medicine wards			
Nurse	10	2	
Doctor	4		
Others	2		
Outpatient clinics			
Nurse	4		
Doctor	2		
Other wards			
Nurse	3		

Discussion

This survey of hospital personnel has documented a high prevalence of symptoms related to use of latex supplies (47.2%), but demonstrable sensitization to latex was considerably lower (12.1%). The response rate to the questionnaire was relatively low (69.3%), but was similar to other studies [7,8,11,13]. The high percentage of symptomatic subjects might be indicative that they were more inclined to respond than workers without symptoms. Taking into account the total number of distributed questionnaires, the percentage of symptomatic subjects would be 32.7% and that of allergic ones only 8.5%.

The prevalence of workers with latex allergy assessed by skin-prick test was 12.1%, which was confirmed by specific IgE CAP in 20 of 24 workers. Sensitization to latex has been found especially in atopic persons (30% of all atopic and 52% of atopic workers with symptoms).

In this study,the prevalence of latex sensitization, considering both the percentage related to the respondents' questionnaires (12.1%) and that related to all distributed questionnaires (8.5%), was higher than estimated prevalence in the general population

(0.7%-1%) [14] and comparable to previous estimates [4,15]. The highest prevalence has been found in the USA and Canada [7,16,17]. Other studies among healthcare workers have reported lower prevalence of latex sensitization, the minimum being 1.5% prevalence among employees of a medical center, whose sera were tested for latex specific IgE by laboratories that used FDA-approved serological tests [18]. The diagnostic sensitivity and specificity of the in vitro assays varied considerably, depending on the sera used and the laboratory performing the evaluation [18].

The variation in reported latex sensitization among healthcare workers can be explained by the differences of diagnostic tests or criteria for the diagnosis of latex allergy. For example, the different quality of NRL allergens in commercial extracts for prick tests, the different content of NRL allergens in gloves used for the prick-by-prick and glove-wearing tests, and the different sensitivity and specificity of latex specific IgE serologic assays may cause difficulties in standardization procedures, illustrating pitfalls and weaknesses of the currently available diagnostic techniques [19]. On the other hand, skin-prick tests and specific serum IgE to latex appear to have limited value in epidemiologic studies of latex allergy [20].

Our findings provide strong associations of latex sensitization to atopy and to the work-related symptoms that were reported in a validated questionnaire. These data confirm other studies showing the risk factors for latex allergy include contact with latex products and atopy [20-22].

The symptoms most frequently associated with use of latex gloves were eczema and redness or itching of the hands. However only 6 of 59 workers (10%) who were patch-tested had latex positive patch tests and 3 were sensitized to rubber chemicals (thiuram, carbamates). In almost all of these workers (52 of 59) symptoms were provoked by the latex-glove-wearing test, but allergic patch test reactions to NRL proteins were uncommon, as previously reported in another study [23]. Latex gloves often contain preservatives, such as dithiocarbamates or phenol-containing compounds, which cause irritant contact dermatitis. Latex gloves also may contain other chemicals (antioxidants, biocides, soaps, etc) used in processing NRL products that may contribute to sensitization. In our study, sensitization to rubber chemicals was found in 3 symptomatic subjects.

Respiratory symptoms seem more specific than cutaneous ones for allergy to latex. In fact, all subjects with respiratory symptoms suggestive of type I hypersensitivity to latex (asthma, rhino-conjunctivitis) presented positive NRL skin-prick tests and specific IgE. On the other hand, only 50% of 16 workers with urticaria, reported as a result of latex glove use, had positive NRL skin-prick tests, confirmed in 6 by positive specific IgE assays.

Described occupational risk factors for latex sensitization among healthcare workers include the duration of wearing gloves (n =13), frequency of changing gloves (n = 4), whether the gloves were powdered (n = 8), and purity of the rubber (n = 8). The extent to which different aspects of glove use influence the development of the disorder is not completely clear.

In this study, the occurrence of respiratory symptoms and type I hypersensitivity, as shown by latex-skin-prick test and specific IgE, was significantly related to the number of pairs of latex gloves used daily (Table 3, Fig 2). A possible factor enhancing sensitization could be the concentration of NRL aeroallergens. Our study confirmed that the healthcare workers that are most likely to become sensitized are nurses employed in operating rooms, intensive care units, and endoscopy units. Exposures to environmental NRL allergens are higher in operating rooms, intensive care units, and endoscopy units (especially cystoscopy), compared to other hospital areas, reflecting the much higher number of latex gloves used daily [25-28]. Environmental static samples have shown a mean NRL allergen concentration of 122 ng/m^3 in operating rooms, 100 ng/m^3 in cystoscopy rooms, 78 ng/m^3 and 46 ng/m^3 respectively in oral and dermatologic surgery units, compared to levels from 0.3 ng/m^3 to 1.8 ng/m^3 in internal medicine outpatient clinics [28]. Recent studies have indicated that use of powder-free NRL gloves reduces drastically the airborne concentration of NRL allergens, and thus reduces sensitization [10,29].

Development of sensitization may be influenced by the chemicals used in processing NRL. These

chemicals may cause irritant contact dermatitis, which is not per se an allergic reaction, but the breaking of the intact skin barrier due to these lesions may afford a pathway for latex proteins to gain access, and thus promote the development of sensitization [30]. Other possible factor enhancing sensitization through inhalation may involve exposure to irritants (eg, glutaraldehyde and other sterilizing solutions, bleaches and cleaners), causing impairment of the mucosal barrier and facilitating the entry of latex antigens [1].

Consistent with previous findings [31,32], the duration of occupational exposure was found in this survey to be a predisposing factor for latex allergy.

In our study, the questionnaire proved to be a very sensitive but nonspecific procedure to identify sensitized workers. In spite of the lack of specificity, validated questionnaires represent the most useful means to implement an effective health surveillance for latex allergy, allowing the detection of workers with symptoms related to occupational exposure at a relatively early stage.

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