

Environmental and clinical study of latex allergy in a textile factory

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Several reports have been published on occupational allergy to latex among health care personnel, and a few of them provide quantification of latex aeroallergens in the workplace.^{1,2}

Immediate hypersensitivity reactions to latex have been described also in workers wearing natural rubber gloves to protect their hands,³ in glove manufacturing plants,⁴ and in a latex-doll manufacturing plant.⁵ To date, no other industrial environment has been identified as being at risk for latex hypersensitivity.

This article reports the results of a medical and occupational hygiene survey in a textile factory, where latex threads (powdered with pure talc to reduce the stickiness of natural rubber) and nylon or polyamide fibers were braided to produce elasticized ribbon for underclothes. Ten workers were employed in the factory, and two of them had been referred to our hospital because of work-related cutaneous, ocular, and respiratory (nasal or bronchial) symptoms. This study set out to ascertain whether allergic manifestations to latex were present among workers and to quantify latex allergen exposure in the workplace.

METHODS

Environmental study

The manufacturing process included opening boxes containing the talc-powdered natural rubber skeins or the nylon and polyamide reels, hand-knotting the threads, watching the power-loom braiding process when the bobbins were unwound and the threads braided at very high speed with pollution of the lubricating powder, cutting the ribbon, and finally sweeping up the dust from and around the machinery. Skin contact with latex and inhalation of the latex-lubricating powder can both happen in the workplace.

Air sampling. On two days, static air samplers and personal breathing zone samplers (Chronos-Zambelli, Milan, Italy) were used to collect seven air samples from various areas of the factory. Static samplers were operated for 3 hours at a flow rate of 3.5 L/min. Personal breathing zone air samplers were worn by four workers during a partial (3 hours) work shift and operated at a flow rate of 3.5 L/min. Airborne particles were collected on 37-mm cellulose ester membranes, with a porosity of 1.2 μ m. Particle size of suspended particulate matter was

Abbreviation used

SPT: Skin prick test

investigated by optical microscopy. A hand-held vacuum cleaner (Black & Decker, Civate, Italy) was used to collect the settled dust.

Quantitation of protein. Protein contents in airborne and settled dusts and in the latex-lubricating powder extract were assayed by using the BioRad method.

Immunoassay for latex allergen potency detection. The powder samples collected in the environment with the filter units were weighed and extracted with phosphate buffer at a 1% wt/vol ratio. The latex thread was used as the reference material; it was extracted with phosphate buffer at a 20% wt/vol ratio (reference latex extract). The RAST-inhibition procedure was used according to the method of Anderson and Baer.⁶ The 50% inhibitory dose, expressed as microliter volume of inhibitor extract calculated on the basis of dilution, was used as a parameter of relative allergenic potency. The same assay was used to determine the allergenic potency of the settled dust.

Clinical and functional study

We used a stepwise protocol. In the initial step of the survey, all workers underwent examination, spirometry according to the official guidelines of the European Respiratory Society,⁷ detection of total serum IgE and specific latex IgE (Pharmacia Cap System, Uppsala, Sweden), and skin prick tests (SPTs). The SPTs were performed with the following: (1) a battery of 15 common aeroallergens (Lofarma Allergeni, Milano, Italy); (2) a commercially available natural latex extract (Lofarma Allergeni); (3) an extract of the latex-lubricating talc powder obtained by incubating 600 mg of the powder collected in the workplace for 12 hours at room temperature in 30 ml of sterile phosphate buffer (pH 6.9); (4) an extract of the pure talc powder obtained as with the latex-lubricating talc powder; and (5) a negative control solution (diluent) and a positive control (0.1% histamine). The allergenic potency of the latex-lubricating talc powder was assessed as described for airborne powder, and 1:100 and 1:10 dilutions were prepared in sterile saline solution.

An SPT reaction was regarded as doubtful (+) when it was less than half the reaction caused by the histamine control solution, weakly positive (++) when it was half the reaction to histamine, clearly positive (+++) when it was the same as with histamine, and strongly positive (++++) when it was greater than the reaction to histamine. Atopy was defined as the presence of one or more positive SPT responses to the common aeroallergen extracts.

In the second part of the study, subjects with atopy or respiratory (nasal or bronchial) symptoms (with or without latex sensitization) underwent a methacholine inhalation challenge

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TABLE I. Characteristics of the four atopic workers with rhinoconjunctivitis and asthma

Patient no.	Common Aeroallergen Sensitization	Total IgE (KU/L)	IgE to latex (KU/L)	SPTs					Methacholine PD ₂₀ (μg)
				Natural Latex	Latex-lubricating talc powder extract			Pure talc powder extract	
					1:100	1:10	Undiluted		
1	Grass	450	<0.35	—	—	—	—	—	115
2	Grass	38	<0.35	—	—	—	—	—	1100
3	Mites	40	0.9	+++	—	++	+++	—	750
4	Grass	373	46.2	+++	—	++	+++	—	310

++, Weak positive, equal to half the reaction to histamine; +++, clear positive, equal reaction to histamine.

performed with a breath-activated dosimeter (ME.FAR, Brescia, Italy), and the PD₂₀ was calculated according to the official guidelines of the European Respiratory Society.⁷

In the third part of the study, subjects with latex sensitization and nonspecific bronchial hyperresponsiveness also underwent specific inhalation challenges with the latex-lubricating talc powder extract and the pure talc powder extract, performed according to a standardized procedure already described,⁸ based on nebulization of 2 ml of increasing concentrations of extracts in a 7 m³ challenge room. The initial extract concentration was a tenfold dilution of the predetermined skin test end-point in the individual undergoing challenge, and the highest concentration was the undiluted extract. Informed consent of the patients was obtained before SPTs and inhalation challenges, which were performed by experienced personnel in a hospital setting where resuscitation facilities were available.

RESULTS

The geometric mean concentration of talc powder collected with static area and personal breathing zone samplers were, respectively, 0.4 mg/m³ (three measurements, range: 0.2 to 0.9 mg/m³) and 0.7 mg/m³ (four measurements, range: 0.3 to 1.1 mg/m³). More than 90% of particles were smaller than 10 microns in mass median aerodynamic diameter. The highest ambient levels were measured while the dust was being swept up, when previously settled powder became resuspended. No protein was detectable in the dust or in the latex-lubricating talc powder extract. No latex allergens were found in the seven air samples, whereas allergenic potency was demonstrated in the settled dust and the latex-lubricating talc powder extract (50% inhibitory dose = 13 μl and 23 μl, respectively).

Six of the ten workers were asymptomatic and had negative SPT responses to latex and common inhalant allergens, negative serum latex IgE, and normal baseline spirometry. Their work seniority ranged from 1 to 19 years (median, 5.5 years). They were not further studied.

Four subjects (Table I) had atopic status and symptoms of seasonal rhinoconjunctivitis and asthma and showed bronchial hyperreactivity to methacholine. Their work seniority ranged from 4 to 13 years (median, 8.5 years). Two of them had negative SPT responses to latex and negative serum latex IgE. The other two (subjects 3 and 4) had positive SPT responses to latex, positive serum latex IgE, and work-related urticaria and rhino-

conjunctivitis. Subject 4 reported also asthmatic attacks in the workplace.

Specific challenges with nebulization of the two talc powder extracts were carried out in subjects 3 and 4. Sneezing, rhinorrhea, and facial flushing were observed in both patients when the undiluted latex-lubricating powder extract was nebulized. Subject 4 also had a 32% fall in FEV₁ from baseline value, starting 10 minutes after nebulization of the undiluted extract and persisting for 2 hours. In subject 3 the methacholine inhalation test was repeated 24 hours after the specific challenge and PD₂₀ was the same as before the challenge (710 μg vs 750 μg). Exposure to the nebulized pure talc powder extract induced no reaction in these two workers. Thus we concluded that two of ten workers had urticaria and rhinoconjunctivitis caused by IgE-mediated latex sensitization, and one subject also had latex-induced bronchial asthma.

DISCUSSION

Our study illustrates occupational exposure to latex in a newly described setting, an elasticized ribbon manufacturing plant, and shows that talc powder used to reduce the stickiness of natural rubber threads can adsorb latex allergens such as cornstarch powder used to lubricate natural rubber gloves.^{1,2}

Unlike the air samples taken in medical centers,² we found measurable latex allergens only in settled dust and not in airborne powder. The absence of measurable latex allergens in the air might be due to the small amount of powder collected by low flow rate sampling or to the small size of the majority of the airborne particles. Swanson et al.² found that latex allergens, although they are distributed throughout all particle size ranges, are largely predominant in particles larger than 14 microns.

To find out whether work-related symptoms in the two atopic subjects with latex sensitization resulted from inhalation of airborne latex allergens bound to talc powder, we used a specific inhalation challenge. Most latex inhalation challenge tests so far have involved handling powdered natural rubber gloves because they were performed in health care workers.¹ Recently, in four nurses with work-related asthma we used a standardized method based on airborne nebulization of incremental doses of latex glove extract, which enabled

us to grade the stimulating doses and minimized the risk of systemic reactions in patients.⁸ In the two textile workers discussed here, airborne nebulization of talc powder extract was the only method of exposure reproducing the risk encountered in the workplace because these workers did not use gloves. Results confirmed that latex-contaminated powder was responsible for their work-related cutaneous, ocular, and nasal symptoms. Only one of the two subjects with latex sensitization had a positive bronchial response to specific challenge testing; the other had only cutaneous, ocular, and nasal symptoms. One could wonder whether the stimulus was sufficient and whether increasing the dose of exposure could have brought on an asthmatic reaction in both subjects. We do not think so because patient 3 had never had asthma at work, and his nonspecific bronchial hyperresponsiveness did not increase after the latex inhalation test.

In conclusion, in agreement with other reports,^{1, 3-5} our data confirm that clinical manifestations of allergy to latex are IgE-mediated, atopy is a common feature, and bronchial reaction to inhalation of latex allergens has an isolated immediate pattern. They also point out that all

workplaces where latex is used can be at risk for latex allergy.

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