

Original article

Latex hypersensitivity in slate workers

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Background: In the course of the last decade, IgE-mediated latex hypersensitivity has become a relevant health problem worldwide. In addition to children with spina bifida, all persons who use rubber gloves in daily activities are at risk to develop this sensitization. Slate processing for roofing and paving is a very common activity in the «Bierzo» region, and workers involved in these tasks use rubber gloves throughout the whole working day (8 to 10 hours, with only a one-hour break for lunch without the rubber gloves). We have assessed the prevalence of latex hypersensitivity in this worker population. **Methods:** The study encompassed 50 slate workers, who were asked to complete a questionnaire in order to collect clinical and epidemiological information. Skin tests with common aeroallergens from our environment, latex and related allergens (chestnut, avocado, banana, and kiwi), extracts of gloves used at home by these workers and extracts of latex gloves were performed. The serum concentrations of specific latex IgE were measured in selected workers. **Results:** Twenty-four subjects (48% of the sample) evidenced some form of clinical symptoms at the workplace. The prevalence of atopy in the study group was 28%. Latex hypersensitivity was demonstrated by means of the skin tests and/or specific IgE levels in five workers. All the subjects with latex hypersensitivity were atopic, and only one of them evidenced sensitisation to the fruits tested. **Conclusions:** The prevalence of latex hypersensitivity among slate workers was 10%, a figure which increased to 20% in those occupied in slate cutting. Slate workers thus represent a new at-risk group for latex hypersensitivity. Atopy was present in all subjects with this sensitization.

Key words: Latex / Latex hypersensitivity / Occupational sensitization / Slate.

Sensibilización al látex en trabajadores de la pizarra

Fundamento: En las últimas décadas, la hipersensibilidad al látex mediada por IgE se ha convertido en un problema de salud de relevancia mundial. Además de los niños con espina bífida, el grupo de riesgo para adquirir esta sensibilización lo constituyen todos aquellos profesionales que utilizan guantes en su trabajo diario. La elaboración de pizarras para techados y pavimentos es una actividad muy extendida en la región del Bierzo, y el personal que se dedica a ella utiliza guantes durante toda la jornada laboral (de 8 a 10 horas, interrumpida únicamente por una pausa de una hora utilizada para comer). Se pretende determinar la prevalencia de sensibilización al látex en este grupo de trabajadores. **Métodos:** El estudio se llevó a cabo en 50 trabajadores, a los que se pidió que cumplimentaran un cuestionario de información clínica y epidemiológica. Se realizaron pruebas cutáneas con aeroalergenos comunes en nuestro medio, con látex y alergenitos relacionados (castaña, aguacate, plátano y kiwi), y con extractos de guantes caseros utilizados por estos trabajadores y de guantes hospitalarios de látex. En casos seleccionados se determinó la IgE específica frente a látex y frutas. **Resultados:** Veinticuatro individuos (48%) presentaban algún tipo de síntoma en su lugar de trabajo. La prevalencia de atopia encontrada en el grupo de estudio fue del 28%. En cinco trabajadores se demostró sensibilización al látex mediante las pruebas cutáneas y/o la determinación de IgE específica. Todos los individuos sensibilizados a látex eran atópicos, y sólo uno de ellos presentaba sensibilización a las frutas probadas. **Conclusiones:** La prevalencia de sensibilización al látex observada entre trabajadores de la pizarra es del 10%, cifra que aumenta al 20% en el caso de los cortadores de pizarra. Esto convierte a este colectivo en un nuevo grupo de riesgo para adquirir sensibilización al látex. Existía atopia en todos los individuos sensibilizados.

Palabras clave: Látex / Sensibilización al látex / Sensibilización ocupacional / Pizarra.

Natural rubber, or latex, is the milky sap from the tree *Hevea brasiliensis*. There are about forty thousand different products manufactured from latex which are frequently used both in daily life and in the hospital environment (rubber balloons, pacifiers, domestic and professional gloves, and many others)¹⁻³.

Over the past few decades, IgE-mediated hypersensitivity to latex has become a health problem with worldwide relevance¹⁻³.

Latex allergens appear to be complex and are not fully characterised²⁻⁵. Significant ones among them are the rubber elongation factor (REF), prohevein, the specific spina bifida allergen, the common fruit epitope, and the so-called airborne allergens.

Besides children with spina bifida, the at-risk group for acquiring this sensitization is constituted by all those professionals who have to use gloves in their daily work⁷⁻¹¹: health workers, cleaning workers and workers occupied in glove manufacturing, among others. The prevalence of latex sensitization among the general population has been estimated to be about 0.4%.

There are in the "Bierzo" region in north-western Spain many slate-manufacturing companies. Slate processing for roofing and paving is a very common activity in this region. The existence of several cases of occupational latex sensitization diagnosed among slate workers at the Occupational Health Unit prompted us to carry out the present study, with the aim of assessing the prevalence of latex sensitization in this population group.

POPULATION AND METHODS

Study population: The study was carried out at a slate-processing factory occupying 55 workers in the day shift and 10 in the night shift. The latter only carry out activities in the quarry; they work with excavating machines, and do not use latex gloves.

Epidemiological data collection: A non-standardised questionnaire was administered to all the workers in the factory. In this way, the initial clinical and epidemiological information was collected. On the day when the skin tests were performed, the questionnaire was reviewed with the worker and the existing doubts were discussed with each subject individually.

Tests performed: Skin prick tests were performed on all the workers studied with the following allergens: commercially acquired latex (C.B.F. Leti, S. A., Spain) (1 mg/ml); home-made extract of latex hospital glove (Ansel Medical Conform, pre-powdered, UK) (this extract was not filtered through Millipore filters); home-made extract of working latex glove I (Marena, reinforced two-colour green and yellow, Igartex S.A.L., Spain); home-made extract of working latex glove II (the same as the above, but not filtered through Millipore filters); home-made extract of PVC working glove (Uro Glass PVC, mustard-coloured, Spain); frequent environmental aeroallergens (*Lolium*, *Betula* and *Dermatophagoides pteronyssinus*) (Alk-Abelló Laboratories, Spain), and fruit allergens (chestnut, banana, kiwi and avocado) (C.B.F. Leti S.A., Spain).

Normal saline was used as the negative control in these tests, and 10 mg/ml histamine as the positive one (Dome/Hollister-Stier, Miles Ltd., UK). All the antigens were tested at the same time in prick on the volar aspect of the forearm (at least 5 cm proximal to the wrist and with at least 3 cm spaces between different antigens). Only the commercial latex extract and the glove extracts were tested in duplicate. Allergy Pricker lancets were used (Dome/Hollister-Stier, Miles Ltd., UK). Wheals 3 mm greater than the negative control were considered positive.

The specific serum IgE to latex, fruits (chestnut, banana, kiwi and avocado) and aeroallergens (*Lolium*, *Betula* and *D. pteronyssinus*) was measured when the skin tests with latex, glove extract or any of the tested fruits had been positive or doubtful or when there were bronchial symptoms suggestive of occupational origin. Seven workers fulfilled at least one of these criteria. The measurements were performed with the CAP System (Pharmacia, Uppsala, Sweden), according to the manufacturer's instructions. CAP levels higher than 0.35 kU/l were considered positive.

Preparation of the homemade extracts: The extracts were prepared on the day of utilisation.

For the preparation of the various glove extracts, a 4 x 4 cm piece was cut from the glove and fragmented into smaller pieces, approximately 0.3 x 0.3 cm. PBS (10 ml) was used as the solvent. The glove - solvent mixture was kept under agitation for 30 minutes at room temperature, and the supernatant was then separated. One

half of the supernatant was filtered through a 0.22 µm Millipore filter (Molsheim, France), and the other half was used without filtering.

Analysis of the protein contents of the extracts: This was carried out at the IPI laboratories using absorption spectrophotometry (sensitivity range, 20 to 2000 ppm).

Statistical and data processing methods: Data entry and tabulation was carried out with an IBM Pentium 150 personal computer, using the Microsoft Access 97 software.

The associations between quantitative variables were examined with the χ^2 test. When the required conditions were not met, Fisher's exact test was used.

The statistical significance level was established *a priori* at $p < 0.05$.

RESULTS

Out of the 55 workers in the day shift, two refused to participate and three could not be studied as

they were on sick leave. The night shift workers did not participate in the study. The questionnaire was thus answered by 50 individuals who agreed to having the skin tests performed.

The study population was almost entirely (92%) constituted of young (mean age, 28.8 years) males. Seventy per cent were tobacco smokers. The observed prevalence of atopy was 28%.

According to the workplace distribution, 16% of the subjects worked outside of the shed, and 80% within it. The trained workers spent practically their whole working time within the shed.

In the shed, 40 workers performed various different functions: cutters (37.5%), shapers (30%), sawyers (20%) and packagers (12.5%).

Twenty-four workers (48%) evidenced some kind of symptoms at the workplace. With the exception on one who evidenced only skin symptoms and eight who evidenced isolated nasal symptoms, 15 subjects reported more than one symptom (nasal and bronchial, ocular and skin) (Table I).

Table I. Clinical and epidemiological characteristics of the symptomatic patients

Case	Gender	Age (years)	Smoking	Previous surgery	T	Activity	Symptomatology			
							Nasal	Ocular	Bronchial	Skin
1	M	36	No	No	180	Yes	Yes	Yes	No	No
2	M	24	Yes	Yes	36	Yes	Yes	No	Nonspecific	No
3	M	29	No	No	204	Yes	Yes	No	No	No
6	M	25	Yes	No	60	Yes	Yes	Yes	Yes	No
12	F	35	Yes	No	96	Yes	Yes	No	No	No
19	M	27	Yes	No	7	No	No	No	No	Yes
21	M	43	Yes	No	240	Yes	Yes	Yes	No	Yes
22	M	29	Ex smoker	Yes	24	Yes	Yes	No	Nonspecific	Nonspecific
23	M	24	No	No	36	Yes	Yes	Yes	No	Nonspecific
24	F	38	Yes	Yes	12	Yes	Yes	No	No	No
25	M	28	Yes	Yes	60	Yes	Yes	Yes	No	No
26	M	23	Yes	No	24	Yes	Yes	Yes	Yes	No
27	F	34	No	Yes	112	Yes	Yes	No	No	Nonspecific
30	M	27	Yes	No	72	Yes	Yes	No	Nonspecific	Yes
32	M	28	Yes	No	84	Yes	Yes	No	No	No
33	M	30	Yes	Yes	180	Yes	Yes	No	No	No
34	M	22	Yes	Yes	24	Yes	Yes	Yes	Nonspecific	Nonspecific
35	M	20	Yes	No	19	Yes	Yes	No	No	No
36	M	25	Yes	Yes	120	Yes	Yes	No	No	No
38	M	37	Yes	No	240	Yes	Yes	Yes	No	No
43	M	26	No	No	120	Yes	Yes	No	No	No
47	M	38	Yes	No	24	Yes	Yes	No	Nonspecific	No
51	M	28	Yes	No	120	No	No	No	Nonspecific	Nonspecific
53	M	24	Yes	Yes	24	Yes	Yes	No	Yes	Nonspecific

M = male; F = female; T = time working in slate manufacture, months; Nonspecific = symptoms without relation to the occupational activity in the case of lower airways symptoms, and irritative complaints in the case of the skin symptoms.

The results of the skin tests are summarised in Tables II and III, and the results of the specific IgE (fruits) measurements in Table IV.

The observed prevalence of latex sensitization was 10%, as revealed by a positive skin test to latex or by a CAP (latex) level higher than 0.35.

The five individuals with latex sensitization were males, with a mean age of 27.6 years; four of them are smokers. All five worked within the shed (three were cutters, one was a sawyer, and the last one was a foreman). Four of them evidenced further symptoms besides the nasal ones (ocular in two cases and bronchial in two cases); only one had exclusively skin symptoms.

Four of the five subjects had positive tests to at least one of the common aeroallergens used in the test panel. In the fifth one, who had negative skin test to mites and pollens, the CAP with *Lolium* and *Betula* was positive. Thus, 100% of the sensitised individuals were atopic, as compared to 28% among the general population.

A statistically significant association was detected between the atopic constitution and the presence of symptoms at the workplace. The proportion of symptomatic subjects among the atopic ones was 73% (11/15), as compared to 37% (13/35) among the non-atopics. Conversely, only

15.4% of the asymptomatic subjects were atopics, as compared to 45.8% among the symptomatic ones (Table V).

No statistically significant association was detected between the type of occupational activity and the prevalence of sensitization (Table IV). The protein contents of the homemade extracts were 0.075 mg/ml for the hospital glove extract, 0.081 mg/ml for the working glove I extract, and 0.204 mg/ml for the working glove II one.

DISCUSSION

Professions and occupations requiring the routine use of latex gloves have been described as at-risk groups for the development of latex sensitization^{1,2}. However, only in some of these occupations have sensitization prevalence studies been performed.

The aim of the present study was to assess a group of worker who, because of their occupational circumstances and the habitual use of latex gloves, may constitute a risk group for latex sensitization. This hypothesis was confirmed by the finding of a 10% prevalence of this sensitization among the study population, a proportion similar to those reported by other authors among health workers and among workers in latex glove manufacturing¹¹. In one particular subgroup, that of slate cutters, the prevalence of sensitization increases to 20%.

Slate is obtained from the quarries in the form of very large stone blocks; these blocks are carried to the manufacturing sheds, where they are sawed into smaller blocks approximately 1/2 to 1 m³ in size. The next step is the cutting or lamination of the blocks, followed by shaping, which

Table II. Results of the prick tests (mm) and of the specific IgE to latex in the sensitized workers

Case	Skin test -latex	IgE -latex	Skin test- working glove I	Skin test- working glove II	Skin test- hospital glove
35	2	1.64	(-)	(-)	(-)
30	3	0.95	(-)	4	4
25	4	0.49	(-)	(-)	(-)
1	5	2.7	3	4	5
19	8	1.67	(-)	7	8

(-) = negative.

Table III. Prick test results with latex and fruits (mm)

Case	Latex	Kiwi	Banana	Chestnut	Avocado
35	2	2	3	5	5
30	3	(-)	(-)	(-)	(-)
25	4	(-)	(-)	(-)	(-)
1	5	(-)	(-)	(-)	4
19	8	(-)	(-)	(-)	(-)

(-) = negative.

Table IV. Results of the prick test with latex (mm) and of the specific IgE assessment (CAP) with fruits (kU/l)

Case	Latex (ST)	Kiwi (CAP)	Banana (CAP)	Chestnut (CAP)	Avocado (CAP)
35	2	0.53	0.71	2.85	2.66
30	3	(-)	(-)	(-)	(-)
25	4	(-)	(-)	(-)	(-)
1	5	(-)	(-)	(-)	0.69
19	8	(-)	(-)	(-)	(-)

(-) = negative.

Table V. Correlation between atopic constitution and presence of symptoms at the workplace

Clinical situation (No. of cases)	Atopic individuals, No. of cases (%)
Asymptomatic (26)	4 (15.4)
Symptomatic, non-sensitized (19)	6 (31.6)
Symptomatic, sensitized (5)	5 (100)

Fisher's exact test, $p < 0.05$.

consists of giving the slate pieces their definitive shape. The shaped pieces are then packaged for transport.

All the processing steps occurring within the shed entail a considerable generation of airborne micro- and macroparticles; the work environment is thus highly dust-laden. Respiratory symptoms at the workplace were present in 48% of the workers.

All the workers within the shed systematically use latex gloves during the 8-to-10-hour work shift, with only a one-hour pause for lunch. The processing line type of work keeps them under conditions of intense physical activity, with marked sweating which is particularly evident in the hands, covered by non-transpirable gloves. Specific or non-specific skin complaints were present in 18% of the study population.

These data give support to the hypothesis of the presence of respiratory and skin irritative mechanisms in the occupational activities of these workers. Such a chronic inflammatory process would facilitate the development of antigenic sensitizations, to latex particles in the present case. Two possible sensitization routes have thus been identified in this population, a respiratory one and a cutaneous one.

The predominance of respiratory symptoms both in the latex-sensitized workers and in the general working population is remarkable. Eighty per cent of they sensitized individuals evidence respiratory symptoms which the associate with their occupation, a finding which suggests the respiratory system as the main route for sensitization. The role of latex as an airborne allergen has already been sufficiently established^{5, 10, 12}.

The added circumstance occurs that the latex gloves used are of low quality, with much less stringent manufacturing and quality control processes than those used for hospitalary-use gloves.

Table VI. Comparison of occupational activity, prevalence of atopy and prevalence of sensitization

Occupation	No. of individuals	Prevalence of atopy (%)	Prevalence of symptoms (%)	Prevalence of latex sensitization (%)
Foreman	2	100	100	50
Cutter	15	40	53.3	20
Packager	5	0	60	0
Shaper	12	8.3	50	0
Sawyer	8	37.5	37.5	12.5
Other	8	37.5	25	0

Fisher's exact test, $p < 0.05$ (non-significant).

The manufacturing processes are important for the final antigenic contents of the product¹³⁻¹⁵. The sensitizing power of the low-quality gloves used in the present case is probably higher than that of hospital gloves. As a matter of fact, the analysis of the protein contents of the glove extracts evidenced a protein content in the working glove extract (0.204 mg/ml) which was three times higher than that in the surgical glove extract (0.075 mg/ml). None of these two extracts had been filtered through Millipore filters.

The study performed with the hospital glove extract was negative in four out of the five latex-sensitized subjects. The one individual with a positive test to the hospital glove extract was the one with the highest latex CAP level. We have not been able to establish if the reason for this negativity was a bad quality of the hospital glove extract, or if the allergenic content in the working glove extract was different from (or greater than) that in the hospital glove one. The greater allergenicity of the working glove extract is supported by the fact that the prick tests with the working glove extracts were positive in three out of the four individuals with positive prick to latex, the exception being the one subject with the lowest CAP level (0.49).

Out of the five latex-sensitized patients, only one evidenced sensitization to the fruits tested. These data are not in agreement with the observations in other groups¹⁶⁻²¹, in which the prevalence of sensitization as determined by the skin tests is in most series as high as 50%. However, those studies have been performed on subjects with clinical latex sensitization, while the clinical relevance of the latex sensitization in those in the present study is still to be ascertained. This may be one of

the reasons for the discrepancy observed. Actually, the individual with the highest CAP level is the one with positive prick tests to the fruits studied.

If the individual working as a foreman is excluded, the mean duration of the working life (with slate) of the sensitized individuals is significantly different from that of the remainder of the workers studied, 39.5 vs. 89.4 months, respectively. This might only mean that previously sensitized individuals had quit this type of work, so that only persons with mild or absent sensitization remained in this occupation. The individual working as foreman had spent 180 months working in the slate manufacture, but his occupation allows him not to use the gloves daily. We would therefore be faced with a group of individuals who have more recently entered this occupation and who have become sensitized, and who probably will end by quitting this occupation.

The prevalence of atopy among the sensitized population is 100%, in keeping with other reports in the literature^{1, 2, 7, 22-24}.

The differences in prevalence found among the various groups may be pointed out as a curiosity. Among the asymptomatic subjects, the prevalence of atopy was 15.4%, while that among the symptomatic but not sensitized individuals was similar to that observed in the general worker population (31.6 and 26.3%, respectively). Among the symptomatic sensitized individuals, the prevalence of atopy was 100%. Conversely, 66.6% of the atopic subjects evidence symptoms, as compared to 40% of the non-atopic ones. These findings suggest a greater predisposition to present symptoms triggered by possibly irritative stimuli among the atopic individuals. One hundred per cent of the sensitized individuals had symptoms, and 100% are atopics.

The five sensitized workers are occupied within the shed. Three of them are cutters, one is a sawyer, and the last one is the foreman, who remains practically all the time in the shed in the cutting and shaping area.

We have tried to assess whether there was any correlation between the type of activity within the company and the presence of sensitization. Among the worker occupied within the shed, who work under approximately similar environmental conditions (the proportions of symptomatic indi-

viduals actually evidenced no significant differences), those with latex sensitization are the ones with a high proportion of atopics (cutters, sawyers and foremen). Among the cutters, the prevalence of sensitization rises up to 20%, indicating that this is probably the working place or occupation with the highest risk for sensitization. However, as the group of sensitized patients was small, no definitive conclusions may be drawn.

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