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Prevention of occupational allergies

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Abstract

In this paper two occupational risk groups are described as examples of prevention of work-related allergy: operating-room nurses of the Erasmus Medical Center and greenhouse workers in the western part of The Netherlands (the 'Westland' region).

Natural Rubber Latex (NRL) allergy is an important health-care problem in the western world. Due to increasing use of rubber gloves, more workers in hospitals and laboratories are exposed to latex allergens. Latex hypersensitivity can induce local symptoms after glove use (usually caused by type-IV allergy to rubber additives), as well as more serious type-I allergic reactions ranging from urticaria and rhinoconjunctivitis to asthma and even anaphylactic shock. Prevalence rates of type-I latex atopy are ranging from 2.8 to 16.9 % for hospital personnel.

We investigated the prevalence of natural-rubber latex allergy in a population at risk (operating-room personnel) in our hospital. This study was asked for by the Board of Directors in order to evaluate the need for a change in type of glove usage at the operating rooms. Regular OR staff members were tested in 1998 for latex allergy. Questionnaires, serologic testing and skin prick tests with different glove extracts were used. The study group comprised 163 persons (response rate 70 %). Twenty-three persons (14.1 %) had specific IgE antibodies against latex. Of these 23 persons, 16 showed work-related type-I allergic symptoms. It was concluded that IgE-mediated allergy to natural rubber latex is a serious problem, also in our institute, and we prompted the Board of Directors to change the glove policy in the entire hospital. During 1999 no more powdered NRL-gloves were purchased.

In 1999, an extensive study among bell-pepper growers showed that 35% was sensitized to bell-pepper pollen. Since a few years bee researchers experiment with bees to discard pollen from bell-pepper flowers. We investigated whether bees can reduce the pollen output in bell-pepper greenhouses and whether this reduction results in a decrease of allergic complaints in the greenhouse workers. Eighteen greenhouses participated in the study. The investigators paid three visits to each greenhouse, complaints during work were asked for, skin prick tests were performed, nasal Visual Analogue Scales were obtained and spirometry was done. In each greenhouse pollen was counted. In 6 and 3 of the greenhouses high and low numbers, respectively, of honeybees were placed throughout the pollen season of the sweet bell-pepper plant. It was found that bees reduced pollen counts in a dose-dependent way. Also, a significant trend relationship between Visual Analogue Score in nasal symptoms and

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exposure to bees was seen. Although the changes in lung function corresponded with the ordering of numbers of bees, statistical significance was not reached. We concluded that the interference of bees in bell-pepper greenhouses significantly reduces the pollen output. Reduction of pollen output decreases the work-related rhinitis symptoms in allergic greenhouse workers. This intervention study demonstrated very clearly that allergic work-related complaints of greenhouse workers, sensitized to bell-pepper pollen, are caused by occupational exposure to this pollen in the greenhouse.
Keywords: exposure; prevalence; prevention; natural rubber latex; sweet bell pepper; occupational allergy

Introduction

Prevention of occupational allergy is in principle reduction of the allergen exposure as much as possible. In this way it is possible to stop the process of sensitization and development of new cases in an occupational risk group (primary prevention). Secondly, one can stop worsening of allergic complaints and development of irreversible occupational asthma and employability (secondary prevention).

Natural rubber latex and health-care workers

Introduction

Natural rubber latex (NRL) allergy is a growing health-care problem. Due to increasing use of rubber gloves, more workers in hospitals and laboratories are exposed to latex allergens. Latex hypersensitivity can induce local symptoms, e.g. hand eczema after glove use (usually caused by type-IV allergy to rubber additives), as well as more serious type-I allergic reactions ranging from urticaria (itchy hives) and rhinoconjunctivitis (sneezing, itchy watery eyes) to asthma and even anaphylactic shock. The clinical symptoms usually arise from direct contact with an NRL product but may also result from inhalation of airborne allergens bound to glove powder. The first report of an immediate type-I allergy to latex proteins goes back to 1927 (Stern 1927); however, more attention to the problem was given after two famous publications in Contact Dermatitis by Turjanmaa (also called ‘the Queen of Latex’) (Turjanmaa 1987; Turjanmaa and Makinen-Kiljunen 1995) and one in The Lancet (Beuers et al. 1990).

The increasing number of scientific publications over the last 10 years is visualized in Figure 1.

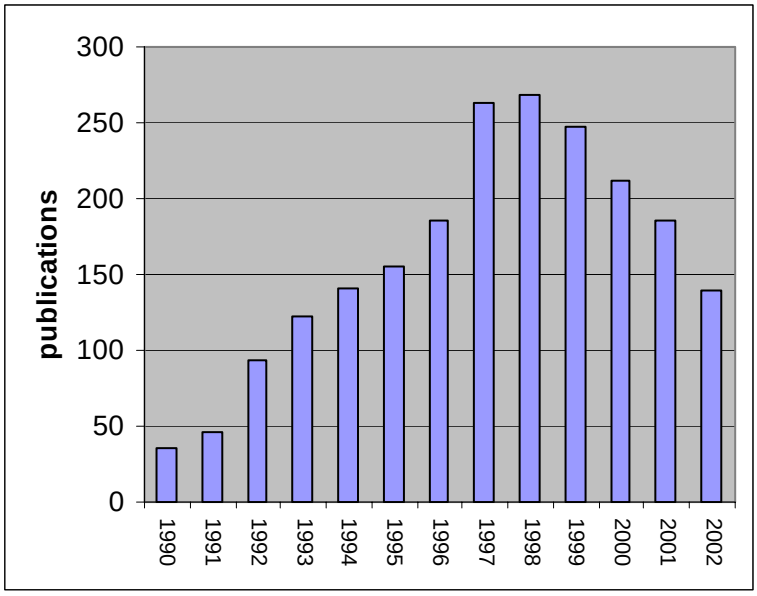

Figure 1. Number of publications found in PubMed concerning latex allergy

The Dutch experience

In The Netherlands only one report regarding latex allergy in health-care workers was found (Van der Meeren, Boezeman and Rampen 1988). All surgeons, gynaecologists and urologists practising in The Netherlands were sent a questionnaire on the incidence of glove-related symptoms. The response rate was 64.0 %. Glove-related dermatitis was reported in 9.5 %, of which 1.1 % consisted of contact urticaria. None mentioned rhinoconjunctivitis or asthma-like symptoms. No confirmatory tests like patch tests or skin prick tests were performed.

In a recent study we investigated, for the first time in The Netherlands, the prevalence of atopy for natural rubber latex in a population at risk (De Groot et al. 1998). For this purpose we studied laboratory workers of the Department of Immunology, Erasmus University, Rotterdam. Approximately 40,000 pairs of powdered NRL gloves were used in 1996 at this department and workers were exposed frequently. Glove-related dermatitis was reported by 37 % of the individuals, the main symptoms being itching and redness of the skin. In only 4 of these 25 individuals, a positive patch test with rubber additives confirmed the diagnosis of 'allergic contact dermatitis'. Glove-related rhinoconjunctivitis was reported by 15 % (i.e., 10) of the participants. In 5 of these 10 cases type-I allergy for latex gloves was confirmed by skin prick testing; all 5 individuals were atopic for inhalant allergens, but unaware of the cause of the glove-associated complaints. In 3 of the 10 cases type-I allergy for latex gloves was confirmed by latex RAST. None reported symptoms of dyspnoea or wheezing, although in 1 individual lung function showed a bronchial hyperreactivity suggesting asymptomatic occupational asthma. This was reported earlier by Vandenplas, who found a positive bronchial response to latex inhalation challenge in nurses without a history of occupational asthma (Vandenplas et al. 1995b).

In summary we found, in accordance with previous investigations in other countries, a high prevalence of glove-related symptoms and NRL type-I and type-IV allergy in laboratory workers exposed to rubber gloves. Furthermore, we showed that regular contact with NRL gloves resulted in two distinct disease groups: a type-I allergic population, all atopics and with a high prevalence of coexisting tropical-fruit

allergy; and a type-IV allergic population without evidence of type-I allergic reactions to inhalant allergens, fruit or NRL. Most individuals were not aware of the existence of latex allergy. There is a compelling need for education and active search for 'patients' in populations at risk like health-care workers. In this way further sensitization to latex allergens and worsening of atopic complaints can be prevented by means of individual as well as work-related measures (Task Force on Allergic Reactions to Latex 1993; Kelly, Sussman and Fink 1996).

Our second study addressed the prevalence of natural-rubber latex allergy in a population at risk (operating-room personnel) in our hospital (Bijl et al. 1999). This study was asked for by the Board of Directors in order to evaluate the need for a dramatic change in type of glove usage at the operating rooms (Vandenplas et al. 1995a). Regular OR staff members of Erasmus Medical Centre were tested in May-July 1998 for latex allergy. Questionnaires, serologic testing and skin prick tests with different glove extracts were used. The study group comprised 163 persons (response rate 70 %), with a mean age of 38 years (range 18-60). Twenty-three persons (14.1 %) had specific IgE antibodies against latex. Persons with an atopic constitution ran an increased risk of latex sensitization (odds ratio 4.3). Of these 23 persons, 16 showed symptoms of urticaria, angio-oedema, rhinoconjunctivitis and/or dyspnoea.

We concluded from these studies that IgE-mediated allergy to natural rubber latex is a serious problem, also in our institute, and prompted the Board of Directors to change the glove policy in the entire hospital. From 1999 on, no more powdered NRL gloves were purchased.

Conclusions

Avoidance of the allergen remains, even in 2004, the most appropriate measure for patients with a latex allergy. The use of low-allergen latex or non-latex gloves throughout the health care sector seems to be an adequate step for health care workers who have natural rubber latex allergy (Allmers, Schmengler and Skudlik 2002; Tarlo et al. 2001). Non-health care workers get along with personal avoidance of latex gloves if they are not working directly with natural rubber latex-containing materials in production. Careful diagnosis and counselling of not only NRL-allergic workers but also employers are important to the achievement of an optimal outcome with glove selection. Information and education of all health care workers is another important goal in the prevention strategy. Without understanding the nature of NRL-allergy, health care workers who do not have NRL allergy may not be willing to change gloves to help their co-workers.

Because of heightened awareness of NRL allergy and changing patterns in glove manufacturing and glove use, it is likely that the occurrence of NRL-induced occupational respiratory disease will decline and its natural history will change. Perhaps in ten years there will be no more new cases of NRL allergy, both in occupational as well as in unselected populations.

Sweet bell-pepper horticulture

Introduction

In 1999, a study in bell-pepper culture in The Netherlands among 472 employees showed that 53.8% had work-related symptoms. Sensitization to the bell-pepper pollen plant was found in 35.4%. Association between positive skin prick test reactions with the pollen and complaints appeared to be 90% (Groenewoud et al. 2002).

Inhalation of the pollen during work is likely because the workers stand very close with their face towards the plants. Contact with the pollen is hardly avoidable and personal protection is proved to be inconvenient and impractical. One solution to protect the employees from sensitization is to reduce the pollen output from the bell-pepper plant. Honeybees as well as bumblebees can be used to pollinate flowers (Delaplane and Mayer 2000). However, application is not common practice, since the bell-pepper plant is a rather good self-pollinator under normal conditions. Furthermore, there are no obvious recommendations for the number of hives needed per surface area of sweet bell-pepper plants. Since a few years the Bee Research Unit of Applied Plant Research experiments with bees to discard the pollen from the flowers. If honeybees indeed were helpful to reduce the pollen load in the greenhouse air, it would lead to a reduction of allergy symptoms. Therefore, the Commodity Board for Horticulture asked us to start a prospective intervention study.

Intervention study

The aim of the study was to investigate whether bees can reduce the concentration of pollen in sweet bell-pepper greenhouses, and whether this reduction depends on the number of bees in the greenhouse. Secondly, whether this reduction is sufficient to reduce the work-related complaints caused by bell-pepper pollen in allergic employees.

Bell-pepper greenhouses in the western part of The Netherlands were approached at random by telephone and asked to participate in the study. Eighteen greenhouses were included and divided into three groups with distinct numbers of honeybees throughout the flower season of the sweet bell-pepper plant. Group I comprised a control group of 9 greenhouses without bees (total area 308,500 m^2, total number of employees 72, number of allergic employees 22). Group II consisted of 3 greenhouses with a low number of bees (total area 61,000 m^2, total number of employees 17, number of allergic employees 8). Group III was a group of 6 greenhouses with a high number of bees (total area 126,500 m^2, total number of employees 44, number of allergic employees 14).

The investigators paid three visits to each greenhouse. During the first visit the volunteers gave informed consent and were asked questions concerning age, sex, medication use, symptoms at work and allergic complaints. Sensitization was determined by means of a skin prick test performed according to international guidelines with homemade extracts of the bell-pepper pollen, and common inhalant allergens (Dreborg and Frew 1993). A 3-mm wheal size was used as an indicator of IgE-mediated allergy. During the first, second and last visit spirometry values and Visal Analogue Scales were determined (Blom et al. 1997).

In January 2002 all greenhouses were visited for the first time. After all measurements were taken, honeybees were placed in the selected greenhouses. All colonies originated from the experimental bee stand at the Bee Research Unit of Applied Plant Research (Hilvarenbeek, The Netherlands). The colonies were healthy and had recently not been used for experiments that might influence their development. During the experiments all colonies were fed with Apifonda sugar.

Approximately 1 colony of 10,000 bees per 10,000 m2 was used in group II; approximately 2 colonies of 10,000 bees per 10,000 m2 were used in group III. The Bee Research Unit paid visits every three weeks to inspect whether the size of the colonies was large enough to warrant good foraging and to check whether the colonies were healthy.

In every greenhouse where bees were placed an Epipen® autoinjector was delivered, to use in case of bee-sting anaphylaxis, and instructions were given to each employee.

During the first two weeks of placement in the greenhouses colony strength (number of bees) generally decreased, probably because the bees got lost in the greenhouse or outside it (open vents). Also the brood area decreased during the first weeks, but then remained rather constant. In most cases after 10 weeks the number of bees decreased, due to a lowered brood production under greenhouse circumstances. Subsequently, the colonies had to be replaced. In all colonies sweet bell-pepper pollen was found in the cells. Pollen-collecting behaviour of the bees was generally higher during the morning than during the afternoon. An interference of crop-protection measures with bee activity was observed: after application of Admire® the bees remained inactive for at least a week. During applications of crop-protection substances, the closed bee colonies were placed in a cool place outside the greenhouse. After re-entering the greenhouse the activity was only slowly re-established. Some owners of greenhouses complained about the bees dirtying the glass surfaces of the greenhouse. This was also the case in greenhouses with a low number of bees. In September and October the bees were remarkably less active in all greenhouses. A possible cause of this phenomenon may be that the flowers produce less pollen in the late season. The plants produce less fruits and November is the end of the season for this cultivation.

The median of the amount of pollen, expressed as percentage of the base line, in the group without bees in measurement 2 versus 1, and 3 versus 1 was 101% and 69%, respectively. The median of the amount of pollen in the group with bees (low numbers) in measurement 2 versus 1, and 3 versus 1 was 33% and 29%, respectively. The median of the amount of pollen in the group with bees (high numbers) in measurement 2 versus 1, and 3 versus 1 was 12% and 18%, respectively (Figure 2).

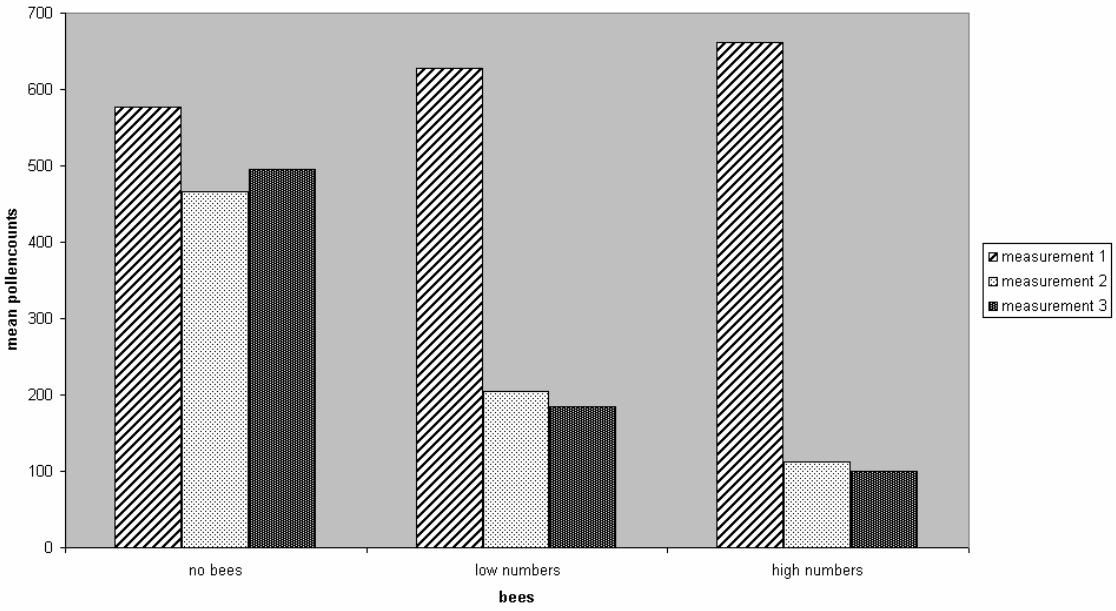

Figure 2. Pollen counts (mean of 6 petri dishes) in greenhouses before intervention and 3 and 6 months, respectively, after introduction of honeybees, in low and high numbers

The workers were not hampered by the presence of the bees, only a few were stung with only local reactions. Therefore the Epipen® autoinjector was not used throughout the study. At month 3 a significant trend relationship of itching, sneezing and droplet

nose with bee concentrations was seen. Blocked-nose and total-nose scores gave no significant results. At month 6 a significant trend relationship of itching and droplet nose with bee concentrations was seen. Sneezing and blocked-nose scores gave no significant results.

Conclusions

The high percentage of pollen-allergic workers (35.4%) in bell-pepper culture forced us to consider possible solutions. The most logic solution is reducing the pollen output. The results of pollen counts proved that the bees could certainly remove pollen from the flowers. The effect on the nose symptoms by lowering the pollen output is satisfactory. A dose–response relationship was demonstrated and in several items (itching, sneezing and running nose) significance was reached. No significant dose–response relation in blocked-nose scores was seen. An explanation could be that changes in chronic nasal blockage are less well perceived by patients than changes in symptoms as sneezing and rhinorrhea. In trend and nominal relationships of lung function and bee numbers significance was not reached. However, it has to be taken into account that the diagnosis of asthma was assessed by questionnaire and not by the inclusion of a test for bronchial hyperreactivity. In addition, the baseline values were in the normal predicted range, so there was less room for improvement. Nevertheless, FVC, FEV1 and PEF slightly improved.

Therefore, we conclude that interference of bees in bell-pepper greenhouses can significantly reduce the pollen output. We found a dose–response relation in the number of bees and a decrease of rhinitis symptoms of the workers. Therefore, this intervention study demonstrated very clearly that allergic work-related complaints of greenhouse workers, sensitized to bell-pepper pollen, are caused by occupational exposure to this pollen in the greenhouse.

Further reading: Cullinan et al. (2003).

References

Allmers, H., Schmengler, J. and Skudlik, C., 2002. Primary prevention of natural rubber latex allergy in the German health care system through education and intervention. *Journal of Allergy and Clinical Immunology*, 110 (2), 318-323.

Beuers, U., Baur, X., Schraudolph, M., et al., 1990. Anaphylactic shock after game of squash in atopic woman with latex allergy. *Lancet*, 335 (8697), 1095.

Bijl, A.M., De Jong, N.W., Mulder, P.G., et al., 1999. Prevalentie van IgE-gemedieerde allergie voor natuurrubberlatex op Rotterdamse operatiekamers. *Nederlands Tijdschrift voor Geneeskunde*, 143 (35), 1780-1784.

Blom, H.M., Van Rijswijk, J.B., Garrelds, I.M., et al., 1997. Intranasal capsaicin is efficacious in non-allergic, non-infectious perennial rhinitis: a placebo-controlled study. *Clinical and Experimental Allergy*, 27 (7), 796-801.

Cullinan, P., Brown, R., Field, A., et al., 2003. Latex allergy: a position paper of the British Society of Allergy and Clinical Immunology. *Clinical and Experimental Allergy*, 33 (11), 1484-1499.

De Groot, H., De Jong, N.W., Duijster, E., et al., 1998. Prevalence of natural rubber latex allergy (type I and type IV) in laboratory workers in The Netherlands. *Contact Dermatitis*, 38 (3), 159-163.

Delaplane, K.S. and Mayer, D.F., 2000. *Crop pollination by bees*. CABI Pub., New York.

Dreborg, S. and Frew, A., 1993. Allergen standardization and skin tests. *Allergy*, 48 (Suppl. 14), 49-82.

Groenewoud, G.C., De Jong, N.W., Van Oorschot-Van Nes, A.J., et al., 2002. Prevalence of occupational allergy to bell pepper pollen in greenhouses in the Netherlands. *Clinical and Experimental Allergy*, 32 (3), 434-440.

Kelly, K.J., Sussman, G. and Fink, J.N., 1996. Rostrum. Stop the sensitization. *Journal of Allergy and Clinical Immunology*, 98 (5 Pt. 1), 857-858.

Stern, J., 1927. Überempfindlichkeit gegen Kautschuk als Ursache von Urticaria und Quinkeschem Odem. *Klinische Wochenschrift*, 6, 1479.

Tarlo, S.M., Easty, A., Eubanks, K., et al., 2001. Outcomes of a natural rubber latex control program in an Ontario teaching hospital. *Journal of Allergy and Clinical Immunology*, 108 (4), 628-633.

Task Force on Allergic Reactions to Latex, 1993. Committee report from American Academy of Allergy and Immunology. *Journal of Allergy and Clinical Immunology*, 92 (1 Pt. 1), 16-18.

Turjanmaa, K., 1987. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis*, 17 (5), 270-275.

Turjanmaa, K. and Makinen-Kiljunen, S., 1995. Natural rubber latex allergy: the European experience. *Immunology and Allergy Clinics of North America*, 15 (1), 81-88.

Van der Meeren, H.L., Boezeman, J.B. and Rampen, F.H., 1988. Contacteczeem door operatiehandschoenen. *Nederlands Tijdschrift voor Geneeskunde*, 132 (21), 963-965.

Vandenplas, O., Delwiche, J.P., Depelchin, S., et al., 1995a. Latex gloves with a lower protein content reduce bronchial reactions in subjects with occupational asthma caused by latex. *American Journal of Respiratory and Critical Care Medicine*, 151 (3 Pt. 1), 887-891.

Vandenplas, O., Delwiche, J.P., Evrard, G., et al., 1995b. Prevalence of occupational asthma due to latex among hospital personnel. *American Journal of Respiratory and Critical Care Medicine*, 151 (1), 54-60.