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Control of airborne latex by use of powder-free latex gloves

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Objective: Our objective was to assess airborne latex allergen exposure in the workplace of a hospital laboratory technician with occupational latex sensitization and repeated anaphylactic episodes from this. Her allergic manifestations had cleared only when coworkers changed to powder-free latex gloves. Therefore a laboratory still using powdered latex gloves was selected for comparative airborne latex sampling.

Design: The design was a survey.

Setting: We used a hospital hematology laboratory, and a biochemistry laboratory was used for comparison.

Participants: The index case with latex allergy is described. An average of 10 employees worked on the day shift in the same laboratory, and 10 employees worked in the biochemistry laboratory studied.

Main outcome measure: Airborne latex allergen levels obtained by high airflow area sampling were compared in the laboratory using powder-free latex gloves and in the laboratory using powdered latex gloves.

Results: Levels were below the level of detection ($<0.02 \text{ ng/m}^3$ of latex allergen) in the laboratory using powder-free latex gloves but ranged from 39 to 311 ng/m^3 in the laboratory using powdered gloves.

Conclusions: Airborne latex allergen is produced with use of powdered latex gloves. Such usage by coworkers may provoke respiratory and anaphylactic response to latex in sensitized subjects. Use of powder-free gloves by coworkers may enable such patients to continue work in their trained profession and may prevent measurable airborne latex exposure. Affected patients, however, still need to avoid direct latex contact. (*J ALLERGY CLIN IMMUNOL* 1994;93:985-9.)

Key words: Asthma, occupational asthma, latex, anaphylaxis

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Anaphylaxis and respiratory allergic responses to latex have been well described.¹⁻⁸ The most common settings for these extracutaneous manifestations are during surgical or dental procedures in sensitized patients (most commonly patients with spina bifida or medical personnel^{3, 4, 6}) and in occupationally exposed subjects.¹⁻³ Local cutaneous allergic responses to latex may be prevented if the patient uses nonlatex gloves. Conversely, anaphylaxis at work or occupational

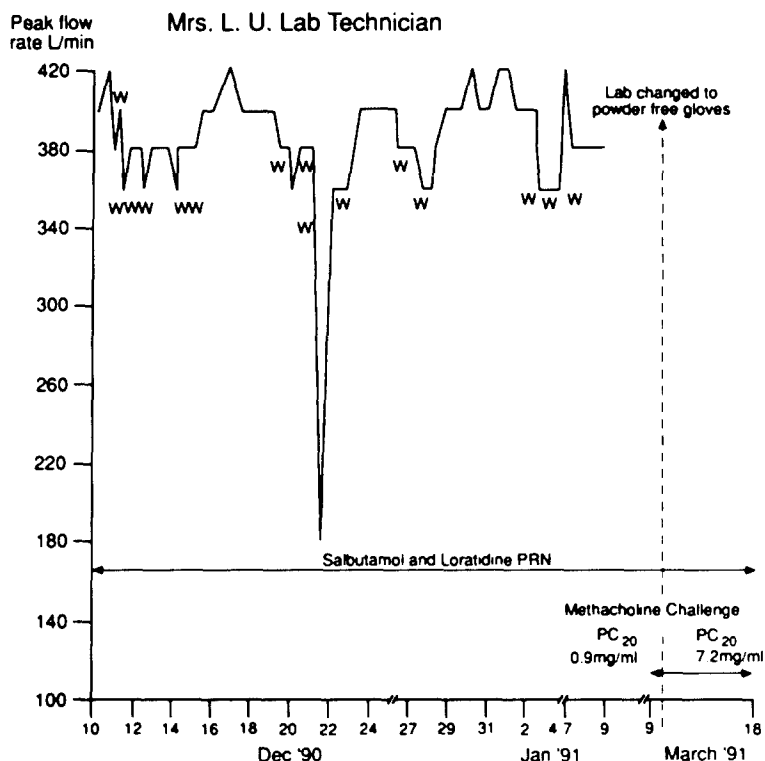


FIG. 1. Peak flow readings at work (W) and off work with personal use of nonlatex gloves but coworkers use of powdered latex gloves.

asthma related to latex is usually not prevented by personal avoidance of latex gloves if coworkers continue to use powdered latex gloves.³ These patients are often highly trained professionals (surgeons, radiologists, anesthesiologists, operating room or intensive care nurses, dental office staff). For such patients to work in a latex-free environment is extremely difficult because even if they themselves use nonlatex gloves, latex gloves may be preferred by their nonsensitized coworkers for tactile sensation and for prophylaxis against transmission of the human immunodeficiency virus and other pathogens. Therefore patients with significant latex allergy may be unable to continue to work in their chosen area of expertise.

It has been suggested that systemic or respiratory occupational responses to latex may result from airborne latex inhalation,^{2, 9, 10} and glove powder obtained from manufactured gloves has been shown to contain rubber proteins.¹¹ The hypothesis that systemic allergic responses could result from transmission by the powder of latex gloves led to an empiric trial of powder-free gloves in the environment of a hospital laboratory technician with latex-related anaphylaxis and asthma. Her excellent tolerance to this environ-

ment has prompted area sampling to determine airborne latex concentrations in her laboratory, in which powder-free latex gloves continue to be used.

CASE REPORT

A 28-year-old female hematology laboratory technician was seen in December 1990 with a 2-year history of contact dermatitis while using latex gloves at work. In addition to the eczematous response on her hands, she also noted contact urticaria. In May 1988 she had had an anaphylactic episode while gloving at work and again experienced anaphylaxis in February 1989 during cesarean section. This occurred within minutes of contact with gloves used by the surgeon. Since then she has used vinyl gloves but despite this noted worsening symptoms at work, with episodic facial urticaria, rhinitis, and wheezing persisting up to 5 or 6 days while off work. On two occasions she had marked angioedema and generalized urticaria, once while at work and once during dental treatment. By history she also had angioedema of her mouth develop when blowing up balloons. She noted no other apparent triggering factors apart from occasional sneezing on close exposure to the cat at home, and a previous history of mild ragweed allergic rhinitis. During this time, the other 15 workers in the laboratory had continued to use powdered latex gloves. Changes to different types of pow-

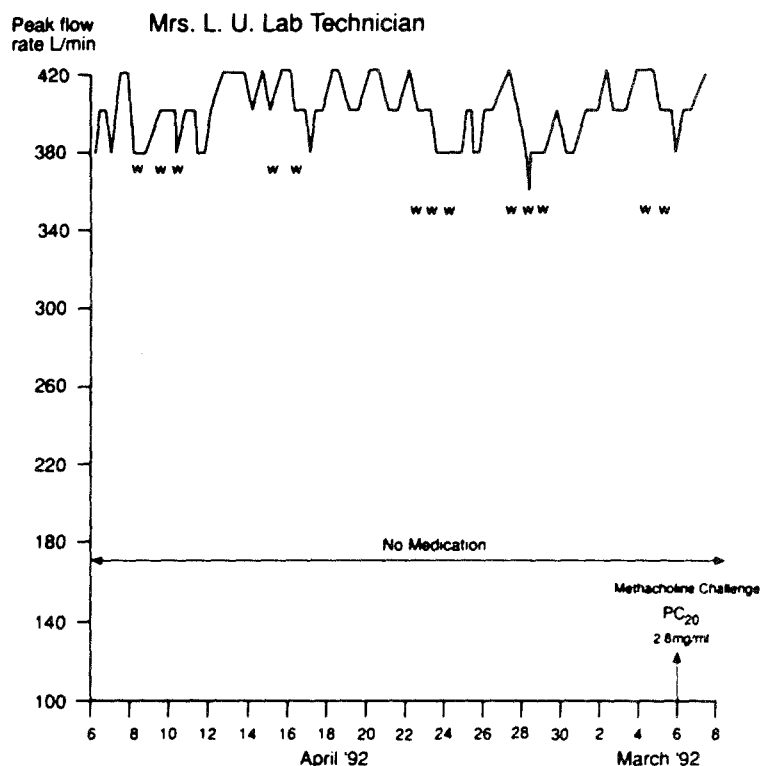


FIG. 2. Peak flow readings at work (W) and off work with use of powder-free latex gloves by coworkers.

dered latex gloves produced little improvement in her symptoms, for which she required intermittent inhaled salbutamol and oral loratadine. Physical examination at this time was unremarkable.

Skin prick testing to 16 common allergen extracts and to latex solution (Bencard Laboratory, Mississauga, Ontario), demonstrated positive weal and flare responses to cat, feathers, cockroach, dust (2+ each), tree, grass pollen (3+ each), ragweed pollen (4+) and low-ammonia latex (4+ >10 mm mean weal diameter). Chest radiograph and pulmonary function test findings were normal (FEV₁ 3.4, 117% predicted; FVC 4.4, 119% predicted; with normal flow rates, lung volumes, and diffusing capacity).

Methacholine challenge showed moderate hyperresponsiveness (PC₂₀, 0.9 mg/ml). Serial peak flow recordings at home and work showed rates ranging from 360 to 380 L/min at work and 400 to 420 L/min on nonworking days. After working a double shift on one occasion she had a significant exacerbation of asthma, flushing, and urticaria, with a peak flow fall to 180 L/min, necessitating treatment in the emergency department (Fig. 1). She stayed off work in January 1991, and 2 weeks later a methacholine challenge showed significantly improved airway responsiveness (PC₂₀, 7.2 mg/ml) while away from work.

A diagnosis of latex anaphylaxis and occupational asthma was made and accepted by the Ontario Work-

ers' Compensation Board. Symptom provocation appeared to occur from airborne latex produced by coworkers' gloves. The laboratory changed to powder-free latex gloves for her coworkers (Diamed Lab Supplies Inc., Mississauga, Ontario) before her return to work in March 1991. Since that time the patient has been free of symptoms except for mild, occasional contact urticaria if she touches a surface, such as a telephone, recently touched by other employees with latex gloves. Peak flow levels have been stable (Fig. 2), and a repeat methacholine challenge on a working day 1 year later showed mild hyperresponsiveness (PC₂₀, 2.8 mg/ml), not significantly different from her previous response while away from work. She has avoided other latex contact. Air sampling of her laboratory was performed for airborne latex in December 1992 and compared with concurrent sampling in a separate laboratory in which powdered latex gloves were used.

METHODS

Air sampling

Area air samplers (Quan-Tec-Air, Inc., Rochester, Minn.) were used to collect air samples from a hospital biochemistry laboratory and from the hematology laboratory of the patient described. Area samplers were operated 6 hours a day, from about 9 AM to 3 PM at a flow rate of 3 L/sec. Airborne particles were collected

TABLE I. Latex levels*

Date	Hematology lab	Biochemistry lab
	Latex (ng/m ³)	Latex (ng/m ³)
Dec. 14	< 0.02	43
Dec. 15	< 0.02	311
Dec. 16	< 0.02	207
Dec. 17	< 0.02	67
Dec. 18	< 0.02	39

*Latex levels measured by area sampling of the hematology laboratory, using powder-free latex gloves, and the biochemistry laboratory, using powdered latex gloves. (Latex results expressed as nanograms of latex allergenic protein/cubic meter air).

onto polytetrafluoroethylene filters that were changed each day.

The index case air sampling was conducted in a combined blood bank/hematology laboratory, a 2400-square-foot area. An average of 10 (range, 8 to 13) employees work during the day shift in this area. Powder-free latex gloves (Diamed Lab Supplies) are worn by the majority of employees, an average of 150 pairs a week. Only three employees (two part time) wear vinyl gloves. (In this laboratory, all the ducts were cleaned and washed, both internally and externally, at the end of October 1992.)

The "control" case air sampling was conducted in the biochemistry laboratory of a different hospital. This laboratory occupies an area of 568 square feet and is part of a central laboratory area housing also the blood transfusion/hematology laboratory and specimen-receiving area (total area of 7900 square feet). There are 10 employees working in the biochemistry laboratory during the day shift (25 total in the central laboratory). Biochemistry staff use an average of 70 pairs of latex gloves each week containing corn starch powder (Baxter nonsterile latex examination gloves, part No. 88581; Baxter Healthcare, Pharmaseal Div., Valencia, Calif.) and 30 pairs of vinyl gloves per week.

Immunoassay for latex aeroallergens

Latex allergens were extracted from the filters in 0.5 ml of 0.1 mol/L phosphate buffer, containing 0.2% bovine serum albumin and 0.01% sodium azide, and assayed immunochemically by an inhibition technique.¹² Extracts of the filters, or a reference laboratory standard extract from latex gloves (Bodyguards brand; T.K. Glove Products, Huntington Beach, Calif.),¹³ competed with solid-phased (Immulon IV Microtiter Wells; Dynatech, Alexandria, Va.) reference latex allergens (Bodyguards brand, T.K. Glove Products) for specific IgE antibodies obtained from sensitized health care workers. The 50% inhibition point of the curve was approximately 100 ng, which was bracketed on either side by the airborne concentrations that were mea-

sured. The glove extract contained 7 mg of protein per milliliter by the bicinchoninic acid protein assay. Radioiodinated affinity purified rabbit anti-IgE was used for detection. The results were calculated by using logistic regression and expressed as latex allergenic protein per cubic meter of air. The sensitivity of the assay was 0.02 ng/m³ when 65 m³ of air was collected.

Air sampling results

Latex levels expressed as nanograms of latex allergenic protein per cubic meter of air were less than 0.02 (the analytical detection limit) on each sampling day in the laboratory using powder-free gloves (Table I). In contrast, levels in the laboratory using powdered latex gloves ranged from 39 to 311 ng/m³.

DISCUSSION

Our findings suggest this patient had inhaled latex-induced anaphylaxis when coworkers used powdered latex gloves. A change to powder-free latex glove use in her environment, while she used nonlatex gloves, was associated with clearing of symptoms. She was therefore able to continue working normally in this environment. The lack of measurable airborne latex in her current environment by area sampling supports our hypothesis that latex becomes airborne from powdered latex gloves and not from powder-free latex gloves. It appears likely that latex allergens become mixed with the glove powder, as previously shown,^{9, 11} and become airborne when gloves are taken on or off. This is in agreement with the findings of Jones et al.¹³ that latex allergen in solutions prepared from latex gloves was lowest from powder-free gloves. However, we only assessed the clinical response and airborne allergen levels with one type of powder-free glove, and therefore our findings cannot necessarily be extrapolated to all powder-free latex gloves.

In comparison, the area sampling of the biochemistry laboratory measured concurrently with the previous laboratory showed latex protein levels up to 311 ng/m³. These levels are similar to those measured in other hospital areas of frequent latex glove usage,¹⁴ for example, operating rooms. These levels are also comparable to previously reported levels of other workplace allergens associated with occupational respiratory allergic responses, such as animal urinary protein levels in laboratory animal research facilities.^{12, 15}

Therefore in patients with occupational rhinoconjunctivitis, asthma, or anaphylaxis associated with latex allergy, a trial of powder-free gloves by all coworkers appears to be a reasonable

approach. However, as in the case of this patient, it is possible that local symptoms may still occur from contact with materials that have been touched by latex gloves. In addition, especially in a hospital setting, inadvertent exposure to airborne latex is still possible from workers in other hospital areas, such as elevators and cafeterias. Therefore caution and advice to continue carrying an updated, preloaded epinephrine syringe is still warranted. As with other patients allergic to latex, all surgical or dental procedures performed must be done with nonlatex gloves and patients must be cautioned against contact with latex products, such as condoms and rubber dental dams. Further studies are required to assess how successful this approach will be in other latex-sensitive patients with asthma or anaphylaxis. In addition, there is a need to assess the comparability and cost-effectiveness of using various other makes of powder-free latex gloves in this situation.

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