

## Prevalence of Latex Sensitization among Hospital Physicians Occupationally Exposed to Latex Gloves

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Patients undergoing surgery who have a history of occupational exposure to latex gloves may be predisposed to intraoperative anaphylaxis caused by latex allergy. Thus, medical personnel who routinely wear latex gloves may be at higher risk than the general population. The prevalence of latex sensitization has not been reported previously among physicians using latex gloves in a North American hospital setting. Using a latex skin prick test (SPT), we determined the prevalence of latex sensitization among 101 staff anesthesiologists, radiologists, and surgeons who regularly use latex gloves and among 100 atopic controls who were not occupationally exposed to latex gloves. Latex SPT was positive in 10 of 101 physicians ( $p = 0.099$ ; 95% confidence interval [CI] 0.041, 0.157) and 3 of 100 controls. Subgroup analysis showed that 9 of 38 atopic physicians were SPT-positive ( $p = 0.237$ ; 95% CI 0.102, 0.372). Atopic physicians were more likely to be latex SPT-positive than either nonatopic physicians or atopic controls (atopic *vs.* nonatopic physicians:  $P = 0.0006$ , odds ratio = 19.2, 95% CI 15.4, 23.1; atopic physicians *vs.* atopic controls:  $P = 0.0005$ , odds ratio = 9.1, 95% CI 7.5, 11.6). We conclude that compared to nonatopic physicians exposed to latex, or nonexposed atopic controls, atopic physicians who wear latex gloves are at increased risk of latex allergy. (Key words: Allergy; anaphylaxis; latex.)

ALLERGIC REACTIONS to latex were first reported in 1987.<sup>1</sup> Subsequent case reports demonstrate that many undiagnosed cases of intraoperative anaphylaxis may be caused by latex.<sup>2-7</sup> It is hypothesized that anaphylaxis occurs when latex in surgeons' gloves or other latex-containing devices (*e.g.*, catheters) is absorbed across the peritoneal or mucosal membranes of sensitized patients (*i.e.*, patients with preformed immunoglobulin E [IgE] antibodies to latex).

Medical personnel who undergo surgery and who have worn latex gloves routinely in the past may be at higher risk of developing latex anaphylaxis than patients from the general population.<sup>8</sup> It is thought that sensitized medical practitioners occupationally exposed to latex gloves develop IgE antibodies after cutaneous absorption of allergenic proteins contained in gloves.<sup>8-10</sup> In 1987, Tur-

janmaa examined the frequency of latex glove allergy among Finnish hospital employees.<sup>11</sup> She reported the highest rate of sensitization among surgical physicians. Physicians with a personal history of atopy appeared to be predisposed to latex allergy.<sup>11</sup>

Since Turjanmaa's study was published, the use of latex-containing material in North American hospitals has increased with the introduction of body substance precaution protocols. Now, at our institutions, latex gloves are worn frequently by surgeons, anesthesiologists, and radiologists. Although anecdotal reports document that anaphylaxis may occur among medical personnel, until now, there have been no attempts to estimate this risk among North American physicians occupationally exposed to latex. The purpose of this investigation is to report the rate of latex sensitization among occupationally exposed physicians in a North American hospital setting in which latex is used commonly. In addition, we extend the observations of Turjanmaa by performing subgroup analysis to estimate the extent to which atopic physicians are at increased risk for latex sensitization. Finally, we offer practical guidelines that may help clinicians recognize and prevent intraoperative latex anaphylaxis.

### Materials and Methods

After human ethics approval had been obtained, a list of surgeons, anesthesiologists, and radiologists employed at the General Division of the Toronto Hospital was obtained from departmental offices. On 2 separate days, attempts were made to contact physicians in their offices, surgical suites, or radiology suites. All physicians who consented to skin prick testing were studied. Physicians not tested included those who refused testing or who were unavailable during the testing days. Additional physicians were recruited from the Mount Sinai Hospital and the Wellesley Hospital, Toronto, in a similar manner. One hundred consecutive atopic patients presenting to an allergy outpatient clinic served as a control population.

Subjects completed a questionnaire examining demographics, atopic history, previous latex reactions, duration and frequency of latex exposure, and outcome of previous surgery.

Atopy status was determined by an allergist (G.S.) who reviewed the questionnaires in a blinded manner. Subjects were considered atopic if they reported previous allergic rhinitis or conjunctivitis, asthma, or eczema. Those re-

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porting isolated reactions to antibiotics or insect bites were considered nonatopic.

Skin prick tests (SPT) were performed on the volar aspect of the forearm using disposable 27-G needles, and the results were evaluated 15 min later.<sup>12</sup> Wheal and flare reactions 5 mm larger than the negative controls were judged positive. Commercially available latex skin test reagent was used (Bencard Laboratory, Mississauga, Ontario, Canada). Normal saline and histamine reagent 1:1,000 (Bencard Laboratory, Mississauga, Ontario, Canada) were used as negative and positive controls, respectively.

Sample size was established using a sample-size calculation to compare the prevalence of latex sensitization in physician and atopic control groups. For this analysis, we used the prevalence published from similar groups of subjects<sup>11</sup> and set critical error levels at  $\beta = 0.25$  and  $\alpha = 0.05$  (two-tailed test). Statistical analysis was performed using Fisher's exact test for comparison of proportions. Statistical significance was set at  $P = 0.05$ . Results are presented using the following nomenclature:  $p$  = proportion with positive skin test; 95% CI = 95% confidence interval; and OR = estimated odds ratio.

### Results

One hundred seventy-nine physicians from three teaching hospitals at the University of Toronto (the General Division of the Toronto Hospital, Mount Sinai Hospital, and the Wellesley Hospital) were eligible for skin testing. Eleven physicians refused to participate: one physician declined because he believed that he would react to the latex allergen; three physicians declined because they feared needles; and the remaining physicians refused to comment. We were unable to contact 67 physicians on the study days. One hundred one physicians, including anesthesiologists ( $n = 43$ ), radiologists ( $n = 28$ ), and surgeons ( $n = 30$ ) were evaluated. One hundred atopic control outpatients were also studied (for demographic data and latex exposure, see table 1).

SPTs confirmed latex allergy in 10 of 101 physicians ( $p = 0.099$ ; 95% CI 0.041, 0.157) whereas 3 of 100 atopic controls were SPT-positive ( $P = 0.082$ ). Nine of 38 atopic physicians were SPT-positive ( $p = 0.237$ ; 95% CI 0.102, 0.372) whereas only 1 of 63 nonatopic physicians were SPT-positive ( $P = 0.0006$ ). The odds ratio between SPT-positive atopic and nonatopic physicians was calculated to estimate the increased risk of latex sensitization conferred by atopic history (OR = 19.2; 95% CI 15.4, 23.1). Atopic physicians also were more likely to be latex SPT-positive than atopic controls ( $P = 0.0005$ , OR = 9.1; 95% CI 7.5, 11.6).

One physician reported that he had experienced an anaphylactic reaction (before dye injection) during a bar-

TABLE 1. Demographic Data

Group	Sex (F/M)	Age (yr) (mean $\pm$ SD)	Occupational Exposure (yr) (mean $\pm$ SD)
Atopic controls	68/32*	38.4 $\pm$ 13.9	0
Atopic physicians	8/30	42.8 $\pm$ 11.9	17.8 $\pm$ 9.8
Nonatopic physicians	17/46†	43.6 $\pm$ 8.2	19.6 $\pm$ 8.2

\*  $P < 0.001$  versus atopic physicians.

†  $P = 0.47$  versus atopic physicians.

ium enema in which a latex catheter was used (table 2). No physicians or atopic controls reported reactions during surgery. Two of the three SPT-positive controls had undergone surgery in the past year without any sequelae.

### Discussion

Latex is a milky sap from the rubber tree, *Hevea brasiliensis*. Recent immunoblot studies demonstrate that at least four polypeptides from natural latex can bind human IgE. Anaphylaxis may result from sensitization to one or more of these polypeptides.<sup>13,14</sup> Natural latex products include surgical gloves, urinary and rectal catheters, dental rubber dams, elastic thread, rubber bands, balloons, and condoms. Life-threatening anaphylaxis has been described during dental or medical procedures in which latex was absorbed across oral, vaginal, or peritoneal membranes at time of surgery.<sup>1,5,9,10,19</sup>

In the current study, 9.9% of physicians and 3% of atopic controls were sensitized to latex ( $P = 0.082$ ). The physician prevalence is similar to that described in previous investigations.<sup>11,15</sup> Turjanmaa<sup>11</sup> found that 7.4% of doctors and 5.6% of nurses from operating units were SPT-positive. However, the outpatient atopic control group prevalence in our study was higher than expected. In a similar group of outpatients this rate was previously reported as 0.8%.<sup>11</sup> Two of the three SPT-positive atopic controls in our study had undergone operations without sequelae within the preceding year. This raises the interesting possibility that they were sensitized during hospitalization.

Although there was a trend toward significance, the difference in the proportion of SPT-positive physicians and atopic controls was not statistically different ( $P = 0.082$ ). The unexpectedly high prevalence among the atopic controls reduced the chance that a significant difference would be seen, for two reasons. First, at the conclusion of the study there was insufficient statistical power to detect any real difference that may exist (*post hoc* power = 0.4).§ Second, by choosing a control group of atopic

§ The number of subjects enrolled was determined by sample size calculations using estimates of control prevalence that greatly underestimated our results.

TABLE 2. Data on Physicians with Latex Allergy

Age (yr)/Sex	Atopy	Occupation	Occupational Exposure (yr)	Previous Latex Reactions
52/M	+	Anesthesiologist	30	—
48/M	+	Anesthesiologist	30	Hand dermatitis
65/M	+	Anesthesiologist	40	Hand dermatitis
31/M	+	Radiologist	10	Hand dermatitis
35/M	+	Radiologist	10	—
39/M	+	Radiologist	8	Anaphylaxis during barium enema
31/M	+	Surgeon	5	Hand dermatitis
37/F	+	Anesthesiologist	10	—
30/M	+	Anesthesiologist	8	—
30/M	—	Surgeon	10	—

patients exclusively, we biased the results against significant findings. Nevertheless, subgroup analysis demonstrated that 24% of atopic physicians were allergic to latex. Physicians in this subgroup were 19 times more likely to test SPT-positive than nonatopic physicians and 9 times more likely to be SPT-positive than atopic controls.

Among the latex-exposed physicians, the presence or absence of hand sensitivity to latex gloves did not reliably predict latex allergy. Four of the 14 physicians who complained of glove irritation were SPT-positive. This is compatible with other studies showing that only a subset of physicians with contact sensitivity to latex gloves have IgE-mediated latex allergy.<sup>5,16</sup> Chemicals added during manufacture of latex gloves (mercaptobenzothiazole, thiurams, carbamates, and phenylenediamine) have been demonstrated to cause symptoms reported by physicians with non-IgE-mediated contact dermatitis to latex gloves. Conversely, individuals may be unaware that they are allergic to latex. In this study, 5 of 10 SPT-positive physicians were asymptomatic. Symptomatic subjects may report a variety of reactions to latex.<sup>8</sup> Many will notice only mild contact hand pruritus, urticaria, and eczematous dermatitis.<sup>1,17</sup> Some patients develop mouth angioedema while blowing rubber balloons.<sup>5</sup> Allergic individuals may also experience rhinitis or conjunctivitis or wheezing, presumably from latex in aerosol form.<sup>14,18</sup>

We identified atopic patients by their response to questionnaires rather than the more rigorous approach that includes skin testing to a battery of common antigens. We omitted additional skin testing for two reasons. First, we believed that physical discomfort and disruption caused by further skin tests might have reduced physician participation and thereby introduced selection bias. Second, we wished to generalize the results of this study to routine clinical practice, and therefore we defined atopy using only information that is normally available at the time of preoperative patient visits.

Skin prick testing was used to determine the prevalence of latex sensitivity.<sup>19</sup> This test was chosen because it poses little risk and is easy to administer and to interpret. The skin test is both sensitive and specific in indicating specific

IgE latex antibody.<sup>20</sup> Other methods are available but have disadvantages.<sup>1,9,11,19,20</sup>

Prospective outcome studies of intraoperative anaphylaxis are unavailable. Without these studies it is impossible to determine the proportion of latex SPT-positive patients who will develop anaphylaxis from latex exposure during surgery. Nevertheless, retrospective studies show that patients with intraoperative latex anaphylaxis are invariably latex SPT-positive.<sup>1-4,6-9</sup> Clinicians must be aware that latex SPT-positive individuals may develop allergic symptoms that may be mild (such as pruritus, rhinitis or conjunctivitis, or urticaria) or severe (such as life-threatening bronchospasm, hypotension, or dysrhythmia) when reexposed to latex.

Based on current knowledge, the following information may assist the anesthesiologist to better manage patients with potential latex allergies:

1. Atopic patients with occupational latex exposure or chronic instrumentation with latex products may be at increased risk<sup>1-7</sup> of allergic reactions to latex.
2. Among physicians exposed to latex gloves, a history of glove symptoms does not reliably indicate latex allergy; conversely, absence of symptoms does not rule out sensitization.
3. Atopic patients who have a history of chronic exposure to latex products or any patient with previously unexplained intraoperative anaphylaxis may be screened by a latex SPT preoperatively.<sup>9</sup>
4. Nonlatex surgical gloves are available and should be used during invasive surgery on latex allergic patients.<sup>5,8,17,21</sup>

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