
Prevalence of IgE to natural rubber latex in unselected blood donors and performance characteristics of AlaSTAT testing

Andrew Saxon, MD*; Dennis Ownby, MD†; Thomas Huard, MD‡; Romain Parsad, MS§; and H Daniel Roth, PhD§

Background: The prevalence of IgE to natural rubber latex (NRL) proteins in the general population remains unsettled, both because of the difficulty of obtaining an unbiased population representative of the general population of the United States and because of concerns about the reproducibility of tests for anti-latex IgE antibodies. Establishing the prevalence in the population is important toward defining the potential risks of persons entering areas where latex exposure may occur.

Objective: The purposes of this study were to determine the prevalence of IgE to latex in a general population and to assess the performance characteristics of the AlaSTAT microtiter plate test for anti-latex IgE when performed independently by different laboratories.

Methods: One thousand nine hundred and ninety-seven consecutive blood samples obtained from the Oklahoma Blood Institute were assayed independently in three laboratories for IgE to NRL using the FDA-approved AlaSTAT ELISA for IgE to NRL. The group consisted of 56% men and 44% women. Ninety percent were Caucasian, 4% African American, and 6% were "other."

Results: The prevalence IgE to NRL between the 3 laboratories varied from 5.4% to 7.6% at the designated cut off of 0.35 kU/L. Examination of results for specific individuals demonstrated >90% agreement between the three sites with the most reproducible results at the Class II cutoff of ≥ 0.7 kU/L. There was no difference in the percent of positive values at the three laboratories.

Conclusions: There is good agreement between laboratories as to NRL IgE reactive and non-reactive sera using the AlaSTAT test. This report of the largest sample of blood donors confirms earlier reports as to the prevalence of IgE NRL in blood donors.

Ann Allergy Asthma Immunol 2000;84:199–206.

INTRODUCTION

While immediate type allergic reactions may have occurred following exposure to natural rubber latex (NRL) for many years, latex allergy has only been commonly recognized since the

late 1980s.^{1–4} IgE-mediated immediate hypersensitivity reactions became the focus of particular attention after serious reactions were observed among children who had medical problems requiring multiple surgeries.⁵ Subsequently a fatality from latex allergy was reported in relation to the latex balloon on a barium enema catheters.⁶ Following these early reports of severe reactions there has been increasing concern about what groups are at risk for latex allergy and whether this risk can be reduced. This lead to attempts to determine the prevalence of sensitization to NRL, as defined by IgE antibodies specific for NRL proteins.

While many persons with IgE to latex do not show clinical reactivity, it is among such sensitized subjects that immediate hypersensitivity reactions may occur.

Multiple reports have suggested children with spina bifida or other urogenital anomalies requiring frequent urogenital surgery are at high risk of developing IgE to NRL.^{5,7,8} Similarly, atopy has repeatedly been found to be a risk factor for sensitization to NRL proteins.^{2,9–13} On the other hand, the role of occupational factors such employment in the NRL or health care industry in causing sensitization to NRL remain inconclusive. Whether the reported prevalence of IgE to NRL of 8.9% to 17.6% in various samples of health care workers represents an increased risk of latex allergy depends upon the prevalence of latex allergy among persons employed in other occupations and as well as factors such as selection bias in the groups studied.^{14,15} Many studies of health care workers lack appropriate control groups of sufficient size to allow valid statistical comparisons between individuals in health care and other occupations. Furthermore, studies comparing controls using different methods of testing, eg, skin testing or even the same method of testing by different investigators may be difficult to compare.

Some have suggested that prevalence of sensitization to latex is as low as less than 1.0% in adult non-health care workers.^{16,17} In contrast, Ownby et al reported that the prevalence of detectable latex specific IgE antibodies was 6.4% in 1000 blood donors using the initial FDA approved AlaSTAT

* Division of Clinical Immunology & Allergy, UCLA School of Medicine, Los Angeles, California.

† Medical College of Georgia, Augusta, Georgia.

‡ Sparrow Hospital, Lansing, Michigan.

§ Roth Associates Inc, Rockville, Maryland. Supported by the Allegiance Health Care Corporation.

Received for publication April 4, 1999.

Accepted for publication in revised form August 12, 1999.

test¹⁸ which was performed in tubes. A subsequent study by the CDC of serum samples obtained during the third National Health and Nutritional Examination Survey (NHANES III) found that 17.6% of that population had detectable IgE antibodies to NRL. The NHANES analysis also used the AlaSTAT tube assay, reducing the probability that the differences between the blood donor study and the NHANES study were related to the use of different assays.¹⁹

The present study was undertaken to further evaluate the prevalence of IgE antibodies to NRL among large numbers of unselected blood donors and to assess the performance of the AlaSTAT assay when performed in parallel by multiple laboratories on large numbers of samples. Beyond the prevalence of latex sensitization in a relatively unselected population, we specifically wanted to learn the reproducibility of the AlaSTAT in different laboratories when large numbers of samples with a low probability of detectable IgE to NRL were processed.

MATERIALS AND METHODS

Blood Samples

Blood samples were obtained 1,997 consecutive adult blood donors from the Oklahoma Blood Institute. The group consisted of 56.3% men and 43.7% women. Of these, 89.6% listed themselves as Caucasian, 3.8% as African American, and 6.6% as other. Blood was allowed to clot before serum was separated. Each serum sample was aliquoted into identically numbered tubes and frozen at -18°C within 5 days of being obtained. After all the samples had been collected, the frozen samples were mailed overnight to the individual test sites. All samples arrived frozen and were kept frozen until being assayed. Samples were not linked to individuals for reasons of confidentiality.

IgE Anti-Latex Assay

Samples were tested for latex specific anti-IgE using the FDA approved AlaSTAT system from Diagnostic Products Corporation, Los Angeles, CA.²⁰ All centers used the AlaSTAT

ELISA automated microtiter plate system. Each center used only sets of reagents from the same manufacturer's lots.

Assay Protocol

A protocol for assaying all samples was established prior to the start of the study and followed throughout the study. Briefly, the manufacturer's recommendations were followed with samples having anti-latex IgE levels of 0.35 kU/L or greater being considered positive. All samples were initially assayed in duplicate independently in each laboratory. If the sample values were ≥ 0.35 kU/L but the duplicates varied by 35%, the sample was reassayed in duplicate. All samples with values between 0.25 and 0.45 kU/L were automatically reassayed in duplicate. This range was chosen because at the 0.35 positive cutoff point the CV of the assay is about 20% and thus 0.25 to 0.45 represents about a 90% confidence interval. On such samples, if the original and reassay data were consistent in terms of being positive or negative, the original value was accepted. If the original and reassay data were inconsistent concerning whether the sample was ≥ 0.35 kU/L, the sample was reassayed a third time in duplicate and the sample was assigned the value of the two consistent assays. Thirty-seven, 115, and 38 samples had to be reassayed at Henry Ford, Sparrow Lansing, and UCLA respectively and of these 1, 2, and 10 had to be reassayed a second time.

For each laboratory the results were tabulated showing the number and percent of positive results (≥ 0.35 kU/L) as well as the minimum, maximum, median, and quartile values for positive results obtained by that laboratory. For analysis, three definitions of positive assays are given, a 0.35 kU/L cutoff, a 0.70 kU/L cutoff, and a 3.50 kU/L cutoff which represent Class I, II, and III reactions respectively as defined by the manufacturer.

An internal positive serum control suggested by the manufacturer was run in all assays. This serum sample was positive to dust mite (*Dermatophago-*

oides farini). This control served as an additional check on results at the three sites. While this additional control is not furnished with the kits as purchased, it is available from the kit's manufacturer (Diagnostic Products Corporation, Los Angeles, CA). The mean levels of dust mite controls ($\pm$ SD) at the three laboratories were 2.13 units (SD = .07, range 1.97 to 2.29) at Henry Ford, 2.53 (SD = .08, range 2.36 to 2.70) at UCLA, and 2.29 (SD = .05, range 2.19 to 2.40) at Sparrow Hospital. The levels at UCLA were statistically significantly greater ($P = .05$) than the other two sites. There was no relationship between the level of reactivity on this dust mite internal control and the percent of samples tested as positive to latex.

As in any in vitro assay, the level of background may affect the percent of reported positive results depending on the difference between the background reading, the variability of the assay and the cutoff established for a positive result. This becomes particularly important when testing a general population where the prevalence of a positive result is likely to be low as higher non-specific background binding will result in more false positive results. To examine this issue, we calculated the mean and standard deviation for all tests having a negative (<0.35 kU/L) value for Henry Ford, Sparrow Hospital, and UCLA. These were 0.043 ± 0.052 , 0.061 ± 0.064 , and 0.005 ± 0.025 respectively. We also analyzed the level of background by determining the distribution of results for the first three quartiles of samples. The third quartile (containing 75% of all readings) for Henry Ford was 0.06; for Sparrow Hospital, 0.10; and for UCLA, 0.00 kU/L. Thus all three laboratories had low of backgrounds in the assays. Treating values below 0.035 kU/L as a continuous variable, there was no statistical difference between the values from the three laboratories. A nonparametric test ranking the levels generated by each laboratory for each subject, however, showed that UCLA generated the lowest values (mean rank 1.25), Ford generated the

Table 1. Number and Percent of the Oklahoma Study Population that are Latex Sensitive at Different AlaSTAT® Cutoff Levels

AlaSTAT® Cutoff Level	Institution	0.35 kU/L		0.70 kU/L		3.50 kU/L	
		# Positive	Rate	# Positive	Rate	# Positive	Rate
Henry Ford		108	5.41	78	3.91	8	0.40
Sparrow Lansing		152	7.61	87	4.36	9	0.45
UCLA		139	6.96	87	4.36	10	0.50

median values (mean rank 2.26), and Lansing had the highest values (mean rank 2.49). The difference in ranks between UCLA and Ford, UCLA and Lansing, and Ford and Lansing were all statistically significant at the <.05 level.

Statistical Analyses

Data tabulations, computation of medians and quartiles, as well as comparisons of results from different laboratories were performed using SAS software programs. Chi-Square and Mantel Haensel tests were employed to assess the statistical significance of differences between laboratories. These latter tests were performed on EXCEL Microsoft software and checked using a hand programmable calculator.

RESULTS

The rate of latex sensitivity by cutoff point and by laboratory is given in

Table 1. Using the suggested 0.35 kU/L cutoff for a positive reading, the rate based on the Henry Ford results is 5.4% as compared with 7.6% for Sparrow Hospital and 7.0% for UCLA. The difference between the rate based on the Henry Ford findings and the UCLA results is statistically significant at the .01 level (Chi-Square 8.0, df = 1) as was the difference between Henry Ford and Sparrow Hospital (Chi-Square 4.1, df = 1). Although the laboratories used identical specimens, identical reagents, and were trained by the manufacturer, the statistically significant different rates suggest an important component of operator dependence is evident in the Class I specimens. For all values of 0.65 kU/L which includes the Class II cutoff (ie, 0.70 kU/L) and above, there are no statistically significant differences be-

tween the data generated by the different labs. At the 0.70 kU/L cutoff, 3.9% were NRL sensitive based on the Henry Ford lab as compared with 4.4% based on the Sparrow Hospital and the UCLA labs. Pairwise comparisons using the Manzel-Haensel test showing that there was no significant difference for all three centers at a value 0.75 kU/L (Table 2). It should be noted that there were no significant differences between the UCLA and Sparrow Hospital results at 0.35 and above. For the 3.5 kU/L cutoff, the rate is 0.4% based on the Henry Ford lab, 0.45% based on the Sparrow Hospital lab, and 0.50% based on the UCLA lab. The overall distribution of the values for the individual samples is given in Figure 1 while the insert shows the distribution of the positive values on an expanded scale. Importantly, the vast majority of values for negative results are well below the 0.35 kU/L cutoff with the mean for the negative values being 0.038 kU/L.

A description of the distribution of positive (≥ 0.35 kU/L) AlaSTAT results from each laboratory is given in Table 3. In pairwise comparisons of the median levels Henry Ford had sta-

Table 2. Discordance Among Centers at Different Cutoff Values (kU/L)

0.35 kU/L				0.55 kU/L				0.75 kU/L			
UCLA	Ford			UCLA	Ford			UCLA	Ford		
	Y	N	Total		Y	N	Total		Y	N	Total
Y	103	36	139	Y	82	26	110	Y	68	15	83
N	5	1853	1858	N	5	1882	1887	N	6	1908	1914
	108	1889	1997		87	1910	1997		74	1908	1914
P value	0.00			P value	0.00			P value	0.08		
						Tc	P value				
UCLA	Lansing			UCLA	Lansing			UCLA	Lansing		
	Y	N	Total		Y	N	Total		Y	N	Total
Y	110	29	139	Y	85	25	110	Y	58	25	83
N	42	1816	1858	N	23	1864	1887	N	26	1888	1914
	152	1845	1997		108	1889	1997		84	1913	1997
P value	0.15			P value	0.89			P value	1.00		
Ford	Lansing			Ford	Lansing			Ford	Lansing		
	Y	N	Total		Y	N	Total		Y	N	Total
Y	98	10	108	Y	75	12	87	Y	60	14	74
N	54	1835	1889	N	33	1877	1910	N	24	1899	1923
	152	1845	1997		108	1889	1997		84	1913	1997
P value	0.00			P value	0.00			P value	0.14		

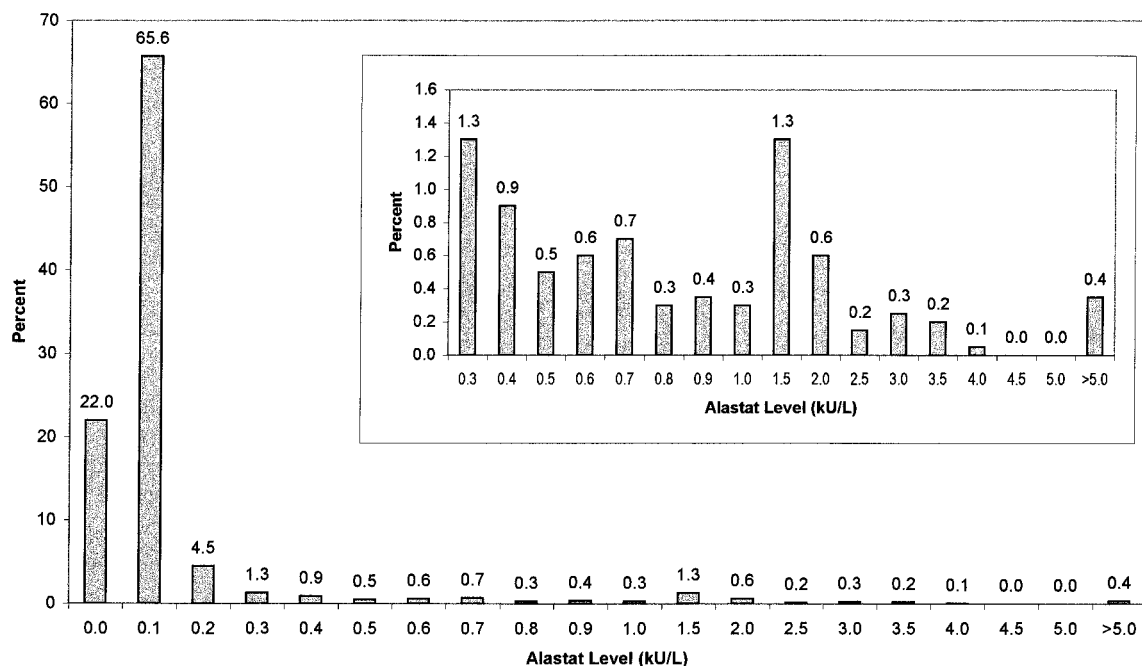


Figure 1. Distribution as percent of total (n = 1997) of latex IgE sample values from the Oklahoma blood donors assayed at Henry Ford Hospital, Sparrow Hospital, and UCLA Medical Center. The average of the value for each sample as assayed the three centers was plotted on this histogram. The mean value for negative samples (values below 0.35 kU/L) was 0.038 kU/L. The insert shows the distribution for values at 0.30 or above on an expanded scale.

Table 3. Summary Statistics of Serum-Positive Anti-Latex IgE Results*

Analyzed at	# Positive	Total Samples	% Positive	Minimum (IU/mL)	1st Quartile (IU/mL)	Median (IU/mL)	3rd Quartile (IU/mL)	Maximum (IU/mL)
UCLA	139	1997	7.0	0.35	0.57	0.87	1.55	44.13
Henry Ford	108	1997	5.4	0.36	0.67	1.01	1.65	30.48
Sparrow Lansing	152	1997	7.6	0.35	0.52	0.80	1.29	16.81

* Positive result was defined as ≥ 0.35 kU/L.

tistically significantly higher levels than Sparrow Hospital ($P < .04$), but this significance disappears after multiple comparison adjustments are made. Any differences in latex positivity rates can not be ascribed to increased general binding in the assay at

the different sites as shown by the level of positive control binding using the internal dust mite controls (see "Materials and Methods").

Of even greater interest is a comparison of results for individual samples assayed in the three participating lab-

oratories. Using the recommended 0.35 kU/L cutoff, 1815 of the 1997 (90.9%) samples are negative in all three laboratories while 94 (4.7%) are positive (≥ 0.35 AU) in all laboratories. Among samples where discrepant results were found, 29 (1.5%) were positive in two of the three laboratories, while 59 (3.0%) were positive in a single laboratory. As shown in Table 4a-c results between laboratories were rarely discrepant by more than one class. Only eight of 1996 samples (0.4%) produced results differing by more than one class when comparing Henry Ford and UCLA, 13 samples (0.6%) when comparing Henry Ford and Sparrow Hospital, and 20 samples

Table 4a. Pair Comparisons of AlaSTAT Results at the Henry Ford Hospital and UCLA

AlaSTAT® kU/L	UCLA Class	Henry Ford Class					Total
		O	I	II	III	IV	
<0.35	O	1853	4	1	0	0	1858
0.35-0.69	I	29	18	5	0	0	52
0.70-3.49	II	6	8	62	1	0	77
3.50-17.49	III	1	0	2	6	0	9
17.50-52.49	IV	0	0	0	0	1	1
	Total	1889	30	70	7	1	1997

Table 4b. Pairwise Comparisons of AlaSTAT® Results at the Sparrow Lansing and UCLA

AlaSTAT® kU/L	UCLA Class	Sparrow Lansing Class					Total
		O	I	II	III	IV	
<0.35	O	1816	32	10	0	0	1858
0.35–0.69	I	20	17	15	0	0	52
0.70–3.49	II	6	15	51	3	0	77
3.50–17.49	III	1	1	2	5	0	9
17.50–52.49	IV	0	0	0	1	0	1
	Total	1845	65	78	9	0	1997

Table 4c. Pairwise Comparisons of AlaSTAT® Results at the Sparrow Lansing and Henry Ford

AlaSTAT® kU/L	Henry Ford Class	Sparrow Lansing Class					Total
		O	I	II	III	IV	
<0.35	O	1835	43	11	0	0	1889
0.35–0.69	I	8	9	13	0	0	30
0.70–3.49	II	2	13	53	2	0	70
3.50–17.49	III	0	0	1	6	0	7
17.50–52.49	IV	0	0	0	1	0	1
	Total	1845	65	78	9	0	1997

(1.0%) when comparing UCLA and Sparrow Hospital.

In 11 cases, UCLA generated higher corresponding levels than Henry Ford and in 46 cases Henry Ford generated higher levels than UCLA. In a comparison of the corresponding results between Sparrow Hospital and UCLA in 94.6% (1889/1997) of the samples, the two labs generated corresponding results, in 60 instances UCLA generated higher results than Sparrow Hospital, and in 48 cases Sparrow Hospital generated higher levels than UCLA. Finally, there is agreement between the Sparrow Hospital and the Henry Ford results in 95.3% (1903/1997) of the cases.

DISCUSSION

The present multicenter study examined the largest number (nearly 2000) to date of unselected subjects for IgE to NRL. It is the only study to have compared results on the same samples assayed at different independent sites while employing the identical FDA approved methodology. Using the generally accepted 0.35 kU/L cutoff for a

positive test, we found that between 5.4% and 7.6% of random blood donors had IgE that reacted with NRL. The combined results from this study are very comparable to the 6.4% obtained with blood donors from Southeastern Michigan.¹⁸ The previous study in Michigan also used the same AlaSTAT testing method. There was some difference in prevalence between the laboratories at the 0.35 kU/L level with Henry Ford showing a statistically decreased percent (5.4) compared with the other two sites (7.0% and 7.6%). This resulted from differences in assigning class O or I values for samples at the low end of the assay range (Table 4a–c). However, here was no difference at the 0.7 kU/L level or above (Table 2). Thus values below the class II cut off should best be considered equivocal even with repeat testing as performed here and certainly a single value in this range should not be taken a proof positive of IgE antibodies to NRL.

In this study, we employed the microtiter plate AlaSTAT ELISA to measure IgE to NRL proteins. The

AlaSTAT ELISA was the first FDA-approved methodology for this purpose in the USA making it a method commonly employed in earlier but less extensive studies. This methodology has been critiqued as being “too sensitive,”²¹ a critique based on what others have expected to find and the results of non-comparable testing, eg, skin testing using non-standardized materials. Furthermore, one can not use clinical reactivity as the “bench mark” against which to determine the specificity of in vitro testing for IgE to NRL or any other common allergen. Indeed, many and often the majority of subjects with IgE to a given allergen may not manifest clinical reactivity, but that does not mean the tests are not a valid measure of IgE to the allergen in question. Thus, as with other allergen testing (skin or in vitro testing), use of the AlaSTAT assay is appropriate for seroepidemiologic studies, whose purpose is to determine the prevalence of IgE antibodies to NRL. In doing so, one has to be aware of the ever present issues of sensitivity, specificity, and the balance between false positive and false negative results depending upon the true prevalence in the population being tested. On the other hand, since many persons with IgE to NRL do not manifest clinical reactivity, this test is not an appropriate clinical screening tool for unselected individuals, as it will identify a large numbers of subjects that do not clinically react. This same situation holds for IgE screening for foods, pollens, and bee venom.

At present, there is no properly standardized skin test reagent for NRL allergen, generally available anywhere in the world, and there is no licensed skin test material in the USA. The availability of a reproducible in vitro methodology such as the AlaSTAT assay allows for standardized testing and comparisons. To achieve this, however, such testing must be reproducible. We therefore undertook a direct comparison of the technology at three different sites. We used the same lots of reagents to test the samples with the results of coded samples being supplied to an independent statistical unit

which had no knowledge of the samples assayed. There was excellent agreement as the value assigned to individual samples at the 0.7 or greater kU/L levels demonstrating favorable performance characteristics of the testing.

The finding that about 7% of unselected blood donors have IgE to latex is not unexpected. Natural rubber latex products are ubiquitous in our environment. Natural rubber latex exposure begins in infancy from exposures to NRL, eg, in bottle nipples and pacifiers.²² Furthermore, NRL particles with detectable NRL allergens have been reported in road side dust as the result from tire wear particles.^{23,24} Second, a very large and growing number of plant materials, including foods and pollens, have been shown to cross-react with NRL protein allergens.²⁵⁻³³ Exposure to these materials begins at infancy, is universal, and IgE antibodies to such materials are common in the atopic population. It is worth noting that the atopic population has consistently shown increased rates of sensitization to NRL. Given these sources of NRL and NRL cross-reacting antigens, our results are comparable to the level of IgE antibody to other commonly encountered antigens such as pollen, bee venom, or penicillin.³⁴⁻³⁷ Indeed, the prevalence of IgE to bee venom, another common allergen, has been found to be between 15% and 25% in unselected populations.³⁸

Grzybowski et al found that 8.8% (95% confidence interval 6.7% to 10.8%) of registered nurses has a positive AlaSTAT ELISA for anti-latex IgE.¹⁴ Given the 90.6% recruitment in that study, the prevalence may have been as low 7.9% due to selection bias in participation by those who felt they might be reactive to NRL. Ledenbom-Mansour et al³⁹ studied 996 surgical patents who were over 18 years old and found sixty-seven (6.7%) had a positive IgE to latex as measured by the AlaSTAT ELISA. Non-Caucasians had greater rates of sensitization than did Caucasians (9.8 versus 4.3, $P = .001$). Porri et al⁴⁰ studied latex sensitization in 258 twenty to forty year old

subjects attending a health screening in France. They found that 6.6% of subjects showed IgE to latex as determined by skin testing or the Pharmacia CAP assay to latex. A study of latex allergy in blood donors from the UK also found a very similar prevalence of latex sensitization at 7.7%⁴¹ as did a report that 8.6% of nursing volunteers were found to be positive for IgE to NRL prior to beginning clinical training.⁴² Given the variability for low positive results as seen in our study when even using the exact same assay and sera, all these cited studies are in a range very similar to what we detected.

Results using the AlaSTAT ELISA can not be directly compared with results using different in vitro techniques. Indeed, Ebo et al⁴³ used a similar assay, the AlaSTAT RIA, a solid phase radioimmunoassay, and the Immuno-CAP to determine the sensitivity and specificity assays for IgE to NRL in Belgium. They found a specificity of only 33% using the ≥ 0.35 kU/L cutoff for the AlaSTAT RIA. If the cutoff was raised to 0.55 kU/L, then the results were comparable to the Pharmacia CAP assay and to the results we report using AlaSTAT ELISA. With the data provided in that paper, one can not access the level of background binding in their work to determine if the assay background was higher than desirable which may have resulted in decreased the specificity at the 0.35 kU/L cutoff. Additionally, the reagents used in AlaSTAT RIA as employed in the Ebo study were research reagents that have been reformulated but remain as research reagents (personal communication, Dr. Jay Weiss, Diagnostic Products Corporation, Los Angeles, CA). Samples (5524) from the third National Health and Nutritional Examination Survey (NAHNE-III) were assayed by CDC using the earlier AlaSTAT tube assay and 17.6% of those samples were positive for IgE antibodies to NR at 0.35 kU/L. This analysis used an older tube version of the AlaSTAT test which employs a static rather than kinetic measurement of antibody interaction. Importantly, the mean level for the negative sam-

ples from NHANESIII was 0.120 kU/L or more than 3-fold higher as compared with the value of 0.038 kU/L in our study. This suggests that increased nonspecific background binding of the sera in NHANESIII assay accounts for the high levels of positivity at the 0.35 kU/L level. This would not be surprising in an assay which is highly operator dependent. Using a 1.5 kU/L cutoff, the NHANES III data would give results that mirrors those seen in our population.

Using a variety of approaches, investigators have attempted to identify populations "at risk for NRL allergy." The early studies employed skin tests or in vitro tests of unknown sensitivity and specificity. Our results show that the general population can appropriately be considered "at risk." Groups reproducibly identified to be at increased risk for sensitization to NRL are persons with spina bifida/multiple genitourinary tract surgery from an early age and persons with atopy.^{5,7-13} While other groups have been suggested to be at increased risk for sensitization due to occupational exposure, eg, health care workers and NRL workers, the data for this is not convincing. The main problem with the studies from which those conclusions are drawn, is that they suffer from major problems with ascertainment bias and failure to include all the necessary controls. Only through carefully designed studies with appropriate control populations, such as we have studied, and by employing reproducible and comparable methodologies can the comparisons be made to determine whether there is an increased risk of latex sensitization from activities such occupational exposure, condom use, or other environmental factors.

ADDENDUM

A recently released report* from the Hazard Evaluation and Technical Assistance branch of NIOSH found that latex sensitization, defined by a positive Pharmacia CAP test of ≥ 0.35 kU/L, was present in 6.3% of hospital employees who did not wear latex gloves and 6.1% of those who did.

These numbers are remarkably similar to the general population of blood donors whom we studied. In addition, that study found no relationship between any parameter of latex glove use, such as duration of employment as a health care worker and latex sensitization. The only positive association with latex sensitization was the presence of atopy. Finally there was no significant difference in work related asthma or general urticaria associated with the presence of latex sensitization.

*Page EH and Esswein EJ. HETA Health Hazard Evaluation Report 98-0096-2737 Exempla St. Joseph Hospital Denver, Colorado, NIOSH, Center for Disease Control and Prevention, United States Department of Health and Human Services, 1999.

ACKNOWLEDGMENT

We would like to thank Ms. Minna Jyräla and Mr. Dennis Keagle for their excellent technical assistance.

REFERENCES

- Carrillo T, Cuevas M, Munoz T, et al. Contact urticaria and rhinitis from latex surgical gloves. *Contact Dermatitis* 1986;15:69–72.
- Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987;17:270–275.
- Seifert HU, Seifert B, Wahl R, et al. Immunoglobulin E-mediated contact urticaria and bronchial asthma caused by household rubber gloves containing latex. 3 case reports. *Dermatosen in Beruf und Umwelt. Occupational and Environmental Dermatoses*, 1987;35:137–139.
- Axelsson JG, Johansson SG, Wrangsjö K. IgE-mediated anaphylactoid reactions to rubber. *Allergy* 1987;42:46–50.
- Gold M, Swartz JS, Braude BM, et al. Intraoperative anaphylaxis: an association with latex sensitivity. *J Allergy Clin Immunol* 1991;87:662–666.
- Ownby DR, Tomlanovich M, Sammons N, et al. Anaphylaxis associated with latex allergy during barium enema examinations. *Am J Roentgenol* 1991;156:903–908.
- Leger RR, Meeropol E. Children at risk: latex allergy and spina bifida. *J Pediatr Nursing* 1992;7:371–376.
- Ylitalo L, Turjanmaa K, Palosuo T, et al. Natural rubber latex allergy in children who had not undergone surgery and children who had undergone multiple operations. *J Allergy Clin Immunol* 1997;100:606–612.
- Dry J, Leynadier F, Pecquet C. Immediate allergy to latex. 12 cases. *Ann Med Intern* 1989;140:691–693.
- Bubak ME, Reed CE, Fransway AF, et al. Allergic reactions to latex among health-care workers. *Mayo Clin Proc* 1992;67:1075–1079.
- Yassin MS, Sanyurah S, Lierl MB, et al. Evaluation of latex allergy in patients with meningomyelocele. *Ann Allergy* 1992;69:207–211.
- Shield SW, Blaiss MS. Prevalence of latex sensitivity in children evaluated for inhalant allergy. *Allergy Proc* 1992;13:129–131.
- Reinheimer G, Ownby DR. Prevalence of latex-specific IgE antibodies in patients being evaluated for allergy [see comments]. *Ann Allergy Asthma Immunology* 1995;74:184–187.
- Grzybowski M, Ownby DR, Peyser PA, et al. The prevalence of anti-latex IgE antibodies among registered nurses. *J Allergy Clin Immunol* 1996;98:535–544.
- Mace SR, Sussman GL, Liss G, et al. Latex allergy in operating room nurses. *Ann Allergy Asthma Immunol* 1998;80:252–256.
- Tomazic VJ, Withrow TJ, Fisher BR, et al. Latex-associated allergies and anaphylactic reactions. *Clin Immunol Immunopath* 1992;64:89–97.
- Turjanmaa K, Reunala T. Contact urticaria from rubber gloves. *Dermatol Clin* 1988;6:47–51.
- Ownby DR, Ownby HE, McCullough J, et al. The prevalence of anti-latex IgE antibodies in 1000 volunteer blood donors. *J Allergy Clin Immunol* 1996;97:1188–1192.
- U.S. Department of Health and Human Services (DHHS). National Center for Health Statistics. Third National Health and Nutrition Examination Survey, 1988–1994, NHANES III Laboratory Data File (CD-ROM). Public Use Data File Documentation Number 76200. Hyattsville, MD: Centers for Disease Control and Prevention, 1996.
- Ownby D. Testing for latex allergy. *J Clin Immunoassay* 1993;22:109–113.
- Slater J. Latex sensitivity. *Medscape Respiratory Care* 1997;1:11–17.
- Yunginger JW, Jones RT, Fransway AF, et al. Extractable latex allergens and proteins in disposable medical gloves and other rubber products. *J Allergy Clin Immunol* 1994;93:836–842.
- Williams PB, Buhr MP, Weber RW, et al. Latex allergen in respirable particulate air pollution. *J Allergy Clin Immunol* 1995;95:88–95.
- Miguel AG, Cass GR, Weiss J, et al. Latex allergens in tire dust and airborne particles. *Environ Health Perspect* 1996;104:1180–1186.
- Petersen A, Vieths S, Aulepp H, et al. Ubiquitous structures responsible for IgE cross-reactivity between fruit and grass pollen allergens. *J Allergy Clin Immunol* 1996;98:805–815.
- Fuchs T, Spitzauer S, Vente C, et al. Natural latex, grass pollen, and weed pollen share IgE epitopes. *J Allergy Clin Immunol* 1997;100:356–364.
- Brehler R, Theissen U, Mohr C, et al. “Latex-fruit syndrome”: frequency of cross-reacting IgE antibodies. *Allergy* 1997;52:404–410.
- Novembre E, Bernardini R, Brizzi I, et al. The prevalence of latex allergy in children seen in a university hospital allergy clinic. *Allergy* 1997;52:101–105.
- Slater JE, Vedvick T, Arthur-Smith A, et al. Identification, cloning, and sequence of a major allergen (Hev b 5) from natural rubber latex (*Hevea brasiliensis*). *J Biol Chem* 1996;271:25394–25399.
- Delbourg MF, Moneret-Vautrin DA, Guilloux L, et al. Hypersensitivity to latex and *Ficus benjamina* allergens. *Ann Allergy Asthma Immunol* 1995;75:496–500.
- Blanco C, Carrillo T, Castillo R, et al. Latex allergy: clinical features and cross-reactivity with fruits. *Ann Allergy* 1994;73:309–314.
- Valenta R, Kraft D. Type 1 allergic reactions to plant-derived food: a consequence of primary sensitization to pollen allergens. *J Allergy Clin Immunol* 1996;97:893–895.
- Beezhold DH, Kostyal DA, Sussman GL. IgE epitope analysis of the hevein preprotein; a major latex allergen. *Clin Exp Immunol* 1997;108:114–121.

-
34. Gergen PJ, Turkeltaub PC, Kovar MG. The prevalence of allergic skin test reactivity to eight common aeroallergens in the U.S. population: results from the second National Health and Nutrition Examination Survey. *J Allergy Clin Immunol* 1987;80:669–679.
35. Barbee RA, Kaltenborn W, Lebowitz MD, et al. Longitudinal changes in allergen skin test reactivity in a community population sample. *J Allergy Clin Immunol* 1987;79:16–24.
36. Adkinson NF Jr, Thompson WL, Maddrey WC, et al. Routine use of penicillin allergy skin testing on an inpatient service. *N Engl J Med* 1971;285:22–24.
37. Sogn D, Evans R, Shepard GM, et al. Results of the NIAID collaborative clinical trial to test the predictive value of skin testing with major and minor penicillin derivatives in hospitalized adults. *Arch Intern Med* 1992;152:1025–1031.
38. Golden DBK, Marsh DG, Kagey-Sobotka A, et al. Epidemiology of insect venom sensitivity. *JAMA* 1989;262:240–244.
39. Lebenbom-Mansour MH, Oesterle JR, Ownby DR, et al. The incidence of latex sensitivity in ambulatory surgical patients: a correlation of historical factors with positive serum immunoglobulin E levels. *Anesth Analgesia* 1997;85:44–49.
40. Porri F, Lemiere C, Birnbaum J, et al. Prevalence of latex sensitization in subjects attending health screening: implications for a perioperative screening. *Clin Exp Allergy* 1997;27:413–417.
41. Merrett TG, Merrett SRN, Kekwick R. Prevalence of latex specific IgE antibodies in the UK. *Ann Allergy Asthma Immunol* 1995;74:50–52.
42. Heese A, Peters KP, Koch HU. Type I allergies to latex and the aeroallergenic problem. *Eur J Surg* 1997;579:19–22.
43. Ebo DG, Stevens WJ, Bridts CH, et al. Latex-specific IgE, skin testing, and lymphocyte transformation to latex in latex allergy. *J Allergy Clin Immunol* 1997;100:618–623.
- Requests for reprints should be addressed to:*
Dr. Andrew Saxon,
Division of Clinical Immunology,
Dept of Medicine,
UCLA Medical School,
Los Angeles, CA 90095-1680
email: asaxon@mednet.ucla.edu
-