Latex Allergen Sensitization Due to Glove Use Among Hospital Staff in Jakarta and Related Factors


ABSTRACT

Aim: to know whether latex sensitization risk among nurses is higher than among administration staff and whether latex sensitization risk among operating room nurses is higher than among ward room nurses and also whether there is a correlation between sensitization and sex, age, duration–frequency of exposure, smoking, or atopic status.

Methods: a cross-sectional study has been conducted in 830 persons from 6 hospitals in Jakarta consisting of 271 operating room nurses, 287 ward room nurses, and 272 administration staff. Subjects completed a guided questionnaire to determine the subject’s age, sex, work setting, duration and frequency of exposure or smoking habits and then the subjects underwent an allergy skin prick test with allergens Der p, Der f, Fel d and latex to determine atopic status and latex sensitization.

Results: the proportion of latex sensitization among nurses was 6.1% and among administration staff 1.5%; there was a significant difference (p=0.002). The proportion between operating room nurses was 6.3% and among ward room nurses 5.9%; there was no significant difference (p=0.974). There was a significant correlation between sensitization and mild or severe exposure or atopic status, but no significant correlation between sensitization and sex, age, duration of exposure, or smoking.

Conclusion: the risk of latex sensitization among nurses is higher than among administration staff, but the risk among operating room nurses was similar to ward room nurses. Atopic status and frequency of exposure were both associated with latex sensitization.

Key words: health-care professionals, sensitization, latex.

INTRODUCTION

Surgical/medical gloves are the end product of natural rubber immersion has advantages to those made of synthetic gloves in terms of elasticity, barrier protection, and durability.1

Natural rubber consists of cis 1-4 polyisoprene, and is the result of extraction from the natural latex Hevea brasiliensis through sap collection and primary preservation with 1.6% ammonium or secondary preservation with 0.15-0.25% ammonia added with sodium pentachlorophenate or tetramethylthiuram disulfide, sodium dimethyldithiocarbonate, and zinc oxide to prevent coagulation. The subsequent process is vulcanization, where the latex is heated with a sulfuric solution to increase elasticity and strength against heat.2

Latex allergen, as with food allergens or insect bite allergens, are proteins that are able to bind with IgE antibodies and are able to cause the activation of an anaphylactic cascade reaction.3

Exposure to latex allergen occurs through direct contact with skin and mucosa, as well as percutaneously, parenterally, or via inhalation of aerosol agents.2

Sensitization reactions following first exposure with latex allergen stimulates plasma cells to form IgE or IgG4-specific antibodies that are strongly bound by basophils and mast cells.6,7

Exposure through the mucosa and parenteral exposure causes a greater risk of anaphylactic reaction compared to that via other routes.3 Since 1988-1992, the FDA has received reports of 1100 cases of allergic or anaphylactic reactions due to latex, with 15 deaths due to invasive procedure with barium enema.8

Allergy to latex products especially occurs in those who have risk factors such as groups who are occupationally exposed to latex (healthcare workers, latex factory workers), groups that undergo frequent surgical procedures (patients with spina bifida/
congenital disorder), and other groups such as those with atopy, women, those allergic to fruit, and those with hand exema.7

The diagnosis of latex allergy is established through anamnesis, physical examination, and skin test using latex allergens or the radioallergosorbent test (RAST) or provocation test.2

Skin tests are used as a standard to detect latex allergy due to sensitivity (100%) and specificity (99%). The allergens used can be made of latex, latex products, as well as Hevea brasiliensis leaves. Currently, the extract can be commercially obtained.2

All healthcare workers are responsible to protect themselves from being infected through their work and from infecting other people through healthcare procedures. This responsibility is known as universal precaution.9 The implementation of universal precaution is very important to protect the healthcare worker and patients.10 Out of various types of gloves, latex gloves are the primary choice due to elasticity and greater ability to prevent infection compared to non-latex gloves.10,11

The prevalence of latex allergy is 1 to 6% in the general population, 8-16% among healthcare workers, and 50% among children with spina bifida, while sensitization reactions among the general population is 1.1%, 2.9% among healthcare workers, and 7% among paramedics working in operation rooms.3,5,12,13

In Indonesia, there are still few case reports or study results of allergic reactions to latex. Karnen et al14 conducted a study on latex hypersensitivity among latex factory workers and 348 workers in two different locations to identify type I allergic reaction and the following results were obtained: 3.2% urticaria, 3.4% rhinoconjunctivitis, and 6.3% asthma. Almost all staff workers with positive latex prick test had atopy. On the other hand, there has been no publication on latex allergy or sensitization among hospital staff.

This study was conducted in order to determine the latex allergen sensitization risk among the paramedics and administrative staff of several hospitals in Jakarta and the risk factors.

METHODS

A cross-sectional observational study was performed on three groups of study subjects, as follows: administrative staff (as control subjects), operation room paramedics, and ward paramedics, from the six hospitals listed above, who volunteered after receiving an explanation on the study. The study began in February 2002 until the number of samples was sufficient. The target population were staff from the selected hospital who fulfilled the inclusive criteria of being active staff, working for over one year, and willing to participate in the study. Potential samples did not fulfill the exclusion criteria were those undergoing antihistamine or immunosuppressive agents, was suffering from a hypersensitivity reaction, and was unwilling to be a study subject. The study variables are positive and negative sensitizations as dependent variables, and the independent variables were work unit, age, sex, duration of exposure, degree of exposure, smoking, and atopy.

The sample was obtained using multi-stage random-sampling. The sample size was calculated using the formula for two proportion hypothesis test.

All study subjects were given a questionnaire to determine sex, age, work unit, duration of work, frequency of glove use, and smoking habit. The written answers to the questionnaires were confirmed to the subject during the prick test. The prick test in this study uses the modified prick puncture test method with the allergens latex Stallergenes, Der p, Der f, Fel d, and histamine as positive control and placebo for negative control.

After the subject has signed the informed consent form, under a drug-free condition (no intake of drugs/traditional medicine one whole week prior to the procedure) and in complete health, the left lower inner arm was disinfected using 70% alcohol while the subject sat down. The alcohol was left to dry, and then the location for allergen drop was marked with a distance of 2-3 cm between allergens, followed by intracutaneous prick using a G26 needle. The assessment of the prick test was performed fifteen minutes after the prick using the assessment criteria based on The Procedure Book of the Department of Internal Medicine of the Faculty of Medicine of the University of Indonesia. The prick test is considered negative if there are no changes in the skin, or it displays a reaction equivalent to that of control. It is considered positive one if there is reaction in the form of a 1-2 mm node, positive two if the node is 3-5 mm, positive three if the node is 6-9 mm and positive four if the node exceeds 9 mm. Sensitization is considered positive if the prick test demonstrates positive two or more.

The data obtained was portrayed as text, tables, and graphs. Statistical analysis was performed using Chi square for nominal variables, t test for scalar numeric variables with normal distribution from two sample groups,
Kruskall-Wallis test for numeric variables with abnormal distribution from three sample groups, Mann-Whitney U for variable with a numeric scale and abnormal distribution from two sample groups as well as logistic regression for several independent variable with nominal scales and dependent variables with dichotomous nominal scales.

RESULTS

Subject Characteristics

From the data collected from February to July 2002, 830 study subjects were recruited from six hospitals in Jakarta, as follows: 476 subjects from Cipto Mangunkusumo National Central General Hospital (272 administrative staff, 132 operation room paramedics, and 72 ward paramedics), 95 subjects from Dharmais Cancer Hospital (51 operation room paramedics and 44 ward paramedics), 71 subjects from Prof. DR. dr. Sulianti Saroso Hospital for Infectious Diseases (29 operation room paramedics and 42 ward paramedics), 65 from Tebet Hospital (12 operation room paramedics and 53 ward paramedics), 68 subjects from the Central Police Hospital (34 operation room paramedics and 34 ward paramedics), and 55 subjects from Harapan Kita Cardiac Hospital (13 operation room paramedics and 42 ward paramedics). From Table 1 we could see that there is a significant difference between the three subject groups when assessed according to the variables sex, age, duration of work, degree of exposure, and smoking, while for the variable of atopy there was no significant difference.

Proportion of Sensitization Reaction

The results of the prick test conducted on the 830 study subjects turned out positive in 38 cases (4.58%) and negative in 792 cases (95.42%). The distribution of sensitization reaction to latex allergen according to group can be found in Figure 1.

Comparison Between the Proportion of Sensitization Reaction Between Operation Room and Ward Paramedics

The comparison of the proportion of sensitization reaction between operation room paramedics and ward paramedics controlled by the variable of atopy and smoking can be found in Table 2. In Table 2 it is shown...
that there is no significant difference among paramedics working in the wards and those working in operation theatres in latex allergen sensitization reaction.

The Correlation Between Independent and Dependent Variables

Table 3 demonstrates a rough correlation between independent and dependent variables. It can be seen from Table 3 that the variables work unit, degree of exposure and atopy with the variables latex allergen sensitization demonstrate a significant correlation, while the variables age, sex, duration of work, and smoking did not demonstrate a significant correlation with latex allergen sensitization reaction.

The Correlation Between Degree of Exposure and Work Unit

From Table 4 it could be seen that the proportion of degree of exposure and work unit has a linear correlation. This explains why work unit also portrays the degree of exposure. Thus, during multivariate analysis, the two variables cannot be analyzed together, in order to avoid collinear effect.

The results of two step logistic regression test, the first stage to see the effect of the degree of exposure on sensitization controlled for atopy and smoking, can be found in Table 5, while the second stage conducted to see the effect of work unit as controlled for atopy and smoking can be found in Table 6.

From Table 5 it can be seen that the influence of the variable mild and severe exposure to sensitization have a significant difference to the influence of non-exposure variable on sensitization. And from Table 6 we can see that there is a significant correlation between the variables work unit and latex allergen sensitization reaction (p<0.05).

**DISCUSSION**

The diagnosis of latex allergen sensitization used in this study is based on the modified prick puncture test method using latex allergen from Stallerpoint,
Stallergenes, SA, France, and utilizes the assessment criteria for medical procedures of the Department of Internal Medicine. This method was chosen because it has a sensitivity of 88-93% and a specificity of 100% and a variability of 8.4 to 16.5% and is safe.\textsuperscript{15-19} This study is limited in that we did not conduct prick testing using fruit allergens that could produce cross-reaction with latex allergen (latex-fruits syndrome), such fruits being banana, pineapple, melon, grape, tomato, potato, chestnut, carrots, kiwi fruit, papaya, apple, avocado, and cherry.\textsuperscript{20-25}

Other limitations are, firstly: this study is unable to dismiss the exposure of latex from other sources aside from gloves among the paramedics and administrative staff. Secondly, the gloves used in the six hospitals were different in type (disposable/reusable) and brand, which could influence the prick test.\textsuperscript{26-29} Thirdly, the participation rates differ among the six selected hospitals, increasing the possibility of selection bias that could influence study results.\textsuperscript{30}

Previous studies show a range of sensitization prevalence rate of 2-44% among healthcare workers due to differences in method and allergens used by individual researchers.\textsuperscript{5} Methods used other than the skin prick tests were questionnaires, scratch tests, and specific IgE serum assessment. The allergens used were local glove extract or standard allergen from Stallergens France or Berncard.\textsuperscript{5}

The results of previous studies from various countries using the same method and allergen in this study demonstrated a prevalence rate of 2.5 to 16.9%, the variation possibly due to racial/genetic differences.\textsuperscript{31} For the control group, representing the general public, the proportion of 1.5% obtained in this study is greater than that found by Turjanmaa et al\textsuperscript{32} of 0.12%. This occurred due to differences in method, race, and allergen. Another possibility is that exposure to latex aside from gloves or indirect exposure to latex allergen among the control group in this study is higher, considering that they work in the hospital, where the level of latex aeroallergen may be higher than in places other than the hospital.\textsuperscript{33}

This study shows a sensitization reaction proportion of 6.1% among all paramedics, which is greater than that of the control group (administrative staff), which is 1.5%, and significantly different with a RO of 5.48 (95% CI 1.85 – 12.24, p=0.002).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Work unit</th>
<th>Administration (%)</th>
<th>Ward (%)</th>
<th>Operation room (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>0</td>
<td>272 (100)</td>
<td>18 (6.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0 (0)</td>
<td>108 (37.6)</td>
<td>26 (9.6)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0 (0)</td>
<td>161 (56.1)</td>
<td>245 (90.4)</td>
</tr>
</tbody>
</table>

Table 5. The Influence of the Variable Degree of Exposure to Sensitization Controlled for Variables Atopy and Smoking

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>p</th>
<th>Odds ratio</th>
<th>CI 95 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td></td>
<td>1.57</td>
<td>4.82</td>
<td>1.341</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>17.312</td>
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<td></td>
<td></td>
<td>1.84</td>
<td>6.29</td>
<td>2.102</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.795</td>
</tr>
<tr>
<td>Atopy</td>
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<td>0.91</td>
<td>2.49</td>
<td>1.278</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4.842</td>
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<td></td>
<td></td>
<td>0.90</td>
<td>2.45</td>
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<td>6.281</td>
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<td></td>
<td>1.45</td>
<td>4.28</td>
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<table>
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<tr>
<th>Variable</th>
<th>B</th>
<th>p</th>
<th>Odds ratio</th>
<th>CI 95 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
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<td>1.70</td>
<td>5.47</td>
<td>1.754</td>
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<td></td>
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<td>17.067</td>
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<td></td>
<td>1.70</td>
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<td>17.285</td>
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<tr>
<td>Atopy</td>
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<td>0.91</td>
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<td>4.808</td>
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<td>0.91</td>
<td>2.49</td>
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<td>1.46</td>
<td>4.32</td>
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<td>21.654</td>
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B : beta coefficient, p significant if < 0.005. CI : Confidence interval
The result of this study demonstrates a proportion rate of sensitization of 5.9% among ward paramedics and 6.3% among operation room paramedics, the differences being non-significant (RO 1.012 95% CI 0.50-2.06, p=0.97), which means that the difference in the risk of latex allergen sensitization among operation room and ward paramedics were not significant, in concordance with the study by Douglas et al.36

This contradictory finding to theory may be due to various possibilities: a rough classification of exposure, the latex allergen level among the two groups have both past the threshold for sensitization, differences in the type and brand of gloves, and differences in participation rates.

The subject in this study was mostly female (78.55%) rather than male (21.45%) with the following proportions of women working in each work unit: 81.92% in the operation room, 91.99% in the wards, and 61.03% as administrative workers, resulting in a significant difference in chi square test result (p=0.000) among the three units. If each of the three work units were compared, there was a significant difference among those working in the operation room as opposed to administrative staff (p=0.000), ward staff and administrative staff (p=0.000), as well as those working in the operation room and those working in the wards (p=0.000).

Sex did not influence sensitization reaction, as reported by Susan M et al,37 Kibby,38 Douglas et al,36 and Yasin.39 However, the study by Largier et al35 demonstrated a higher prevalence rate of latex allergen sensitization among women as opposed to men (9:1). This is due to the greater number of females (87%) as opposed to males (13%). Another reason why females are more frequently sensitized by latex allergen is because women are more frequently exposed from work as well as medical procedures.7

In this study, there was no significant correlation between sex and sensitization (p=0.384) even though 78.6% of study subjects were female.

The mean age of the study subjects was 35.75 years, with a standard deviation of 9.49 and a median age of 35 years. Using Kruskal Wallis test, there was a significant difference between the three subject groups (p=0.000), and if the results were further assessed using t test, a significant difference was found between the operation room work unit and the administrative staff (p=0.003), between the ward group and the administrative staff group (p=0.000), as well as between operation room and ward staff (p=0.000).

Latex allergen sensitization is particularly found among the young, due to type I allergy reaction, commonly found among the young,40 while other factors are that productive ages dominate the work force, thereby increasing the risk of exposure to latex allergen, including those who work as nurses.40

If we correlate age and sensitization, no significant correlation was found, which is in line with the study reported by Kibby et al38 and Douglas et al36

Latex gloves contain allergen bound to the gloves themselves or to the talc used as lubricant.26,41,42 The allergen is derived from natural rubber that is used or rubber proteins altered by additional substances used in the production process.5,26-29,43-46

The use of latex could cause latex allergen exposure through direct contact with the intact skin of the hand and more severely if the skin of the hand is no longer intact, or through inhalation of latex aeroallergen from the talc in the gloves.6

The duration and frequency of exposure illustrate the cummulative amount of latex allergen exposed to a person, whereby the longer and the more frequent the exposure, the higher the level of allergen that person is exposed to. This means that there is a higher possibility of positive sensitization reaction to latex allergen.

References state that latex allergen sensitization reaction is influenced by: level of allergen, duration, frequency, and the way of exposure as well as the individual’s immune status.5,6

The results of the study on the correlation between the duration and frequency of exposure with the incidence of sensitization reaction to latex allergen demonstrate different results. Susan M et al37 reported their study result that demonstrate 0% prevalence rate of sensitization in the first and second years of exposure, 3% in the third year, and 6% in the fourth, as well as 10% after 8 years of more of exposure, in line with literature. On the other hand, Kibby et al,38 Douglas et al,36 and Yasin et al,39 did not found a significant difference between positive sensitization reaction when related to the duration and frequency of exposure.

In this study, the duration of exposure among all study subjects were 12.69 years, with a standard deviation of 8.69. The three subject groups demonstrated a significant difference when assessed using the Kruskal Wallis test. When assessed further using T-test, a significant difference was found among the operation room group unit and the administrative staff, with p=0.004. This significant difference was also found among the ward work unit group and the administrative staff.
When the duration of exposure is associated to sensitization, no significant correlation was found between the duration of exposure and sensitization reaction to latex allergen, in accordance to the study by Douglas et al.36 A factor that may cause a difference in the study result include whether the received level of allergen has passed the threshold, thereby producing immediate positive latex sensitization reaction. This is in line with the report of a study by Baur et al47 who found 0.6 n/m3 to be the threshold latex aeroallergen level for sensitization.

The highest degree of exposure is found among the operation room work unity, followed by ward staff, while no exposure was identified among administrative staff. Using chi square, a significant difference was found between the ward and operation room work units (p=0.000).

Using chi square to assess the relationship between degree of exposure and sensitization, a significant correlation was found between the exposed group (degree of exposure 1 and 2) and the control/unexposed group (degree of exposure 0). The group with mild exposure has a sensitization risk 5 times higher than the unexposed group (RO 4.82 95% CI 1.34 – 17.31 p=0.016), while the severely exposed group has a sensitization reaction six times higher than the risk in the unexposed group (RO 6.29 95% CI 2.10 – 18.80 p=0.001). This is in line with references that state that healthcare workers are in the high risk group of suffering from latex allergen sensitization.5

However, if the low and high degree/frequency is correlated to sensitization, no significant difference was found (RO 1.30 95% CI 0.55 – 3.21 p=0.55), this may be due to a threshold level for sensitization that is beyond the low as well as high degree of exposure, differences in the type and brand of gloves, and rough classification of degree of exposure and selection bias in this study.

A proportion of the study subjects were smokers (11.57%), with the highest proportion among administrative staff (19.11%), followed by operation room staff (9.96%), and ward staff (6.275%). Using chi square statistical test, a significant difference was found among the three subject groups (p=0.000), while the comparison between the two groups demonstrated a significant difference among operation room and administrative staff (p=0.000), while no significant difference was found between operation room and ward staff (p=0.109).

The proportion of atopy among all study subjects in this study was 33.61%, with details as follows: 34.69% in operation room paramedics, 32.75% among ward paramedics, and 33.46% among the control group. There was no significant difference among the three groups.

The significant correlation between atopy as a predisposing factor with latex allergen sensitization was higher than that reported by previous researchers.5 Available previous reports demonstrate latex allergen sensitization prevalence rates of 1.2 to 4.5% among atopic individuals using the skin prick test method, and 16.6% using the serum specific IgE assessment method.5 The result of this study also demonstrates a significant correlation between atopy and latex allergen sensitization (RO 2.49 95% CI 1.28-4.84 p=0.007) with a prevalence rate of 7%.
CONCLUSION

The risk of latex allergen sensitization among paramedics is higher than among administrative staff, while the risk of latex allergen sensitization among paramedics working in operation rooms was equivalent to that of paramedics working in the ward.

Latex allergen sensitization reaction is influenced by the degree of exposure and atopy, but is not influenced by sex, age, duration of exposure or smoking.

In order to obtain better results, studies should be performed using latex allergen and fruit allergens that could cause latex-fruits syndrome, and study subjects using the same type and brand of gloves should be selected, equal participation rate should be calculated using the same type and brand of gloves should be

The expected benefit of this study, in addition to providing the first data on latex sensitization among hospital staff in Indonesia, is also to achieve further benefit of prevention through the formulation of standard procedure in dealing with allergic reaction to latex as well as the anticipatory procurement of latex-free areas.

REFERENCES

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