

Latex allergy, a special risk for patients of otorhinolaryngology and head and neck surgery?

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Abstract

A total of 206 patients of the otorhinolaryngology (ORL) department and 204 of the visceral surgery department of the Ludwig Maximilians University of Munich were preoperatively evaluated for latex-specific sensitization. A prick test, a questionnaire, and an enzyme-linked immunosorbent assay immunoprecipitation for IgE antibodies were performed. Latex is a widely spread allergen, and it does not only concern healthcare populations. Within the ORL surgery group, 43 (20.9%) patients were sensitized against latex allergen, and 2 of them were reported to manifest symptoms in consorting with latex. In the cohort of visceral surgery patients, we detected only 23 patients (11.3%) with sensitization against latex. Moreover, most patients were positively detected with the skin prick test (86.4%), whereas the enzyme-linked immunosorbent assay method was less sensitive (18.3%). Patients of the ORL department were considerably more frequently exposed to latex protein particles than patients of the visceral surgery department. This difference attributes to their significant difference in mean age: 44 years in the ORL patients group versus 58 years in the visceral patients cohort. Furthermore, we did not find any correlation to the number of past operations—although undergoing any surgical procedures is a well-known risk factor in other studies about latex sensitization in surgical patients.

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1. Purpose

Natural rubber latex (NRL) is a ubiquitous allergen because it is a component of more than 40,000 products in everyday life [1]. Latex allergy might be attributed to skin contact or inhalation of latex particles. Latex allergy is an IgE-mediated hypersensitivity to NRL allergen presenting a wide range of clinical symptoms like angioedema, swellings, cough, asthma, and anaphylactic reactions. Very small amounts of aerogen latex protein intake might evoke latex

allergy. Furthermore, NRL-allergic patients could show allergic response to fruit and other food, like bananas, kiwi, and avocados, because of the proteins' cross-reactivity known as the latex-fruit syndrome. Until 1979, latex allergy appeared only as type IV delayed way of hypersensitivity, afterward the proportion of the different allergy types drifted toward type IV contact allergy reactions. Nevertheless, the classification of Coombs and Gell [2] is quite useful in a didactical way, but in vivo, cellular sequences may influence each other or end up simultaneously [3]. However, latex is a widespread allergen concerned with healthcare populations, and it plays a pivotal role in patients undergoing surgery. Moreover, latex allergy has proven to be an increasing problem concerning socioeconomic aspects (Table 1).

Little is known about differing prevalence rates among various disciplines of surgery. Exact incidences are still unknown, but the table above gives a short overview about

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Table 1

Epidemiological data about prevalences in latex allergy

Spina bifida patients	20%–65% [9,27]
Healthcare professionals	10%–15% [21]
Nonhealthcare professionals with NRL exposure	10%–12% [29]
Individuals with atopy and NRL exposure	36% [7,20]
General population with history of atopy	8%–17% [21]
..Without history of atopy	1%–6% [21]

study-based data concerning prevalence rates. Several risk factors in sensitization to NRL are already known and well documented [4,5]. Some authors established a positive correlation between a history of multiple surgical interventions, atopy, spina bifida malformation, and latex allergy incidence [6,7]. Atopy is defined by Ring [8] as a family history of atopic diseases like rhinoconjunctivitis, asthma, and eczema in correlation with an increased IgE production and/or a change in unspecific reactivity. Patients with atopy are exceedingly endangered to develop NRL sensitization after latex exposition. Hence, atopy has also been documented to be an important risk factor [9]. We suspect an increase of latex allergy incidence in association to increased atopy and sensitivity to environmental allergens in industrial population [4]. The increased prevalence of life-threatening diseases, such as HIV infection and hepatitis (HBV and HCV), has resulted in a boost in the use of gloves in healthcare. It is often postulated in literature that the groups of workers at risk are essentially workers in the latex industry and healthcare professionals [10].

We referred to several factors contributing to the incidence and risk of developing NRL allergy. Recurrent latex exposition to skin or mucosa leads to NRL sensitization [5]; therefore, we looked at frequencies of invasive surgical interventions in our study subjects. Direct intraoperative exposure to latex in allergic patients may cause anaphylactic shock conditions and might lead to a serious outcome. In this population, direct internal and mucosal contact with NRL medical devices may be the rout of sensitization, as factors such as number of procedures and use of NRL materials, such as catheters and tubes, was associated with increased risk of latex sensitization and allergy.

The aim of our study was to evaluate concrete prevalence rates and possible risk factors for patients of the otorhinolaryngology (ORL) department in comparison with patients of the department of abdominal surgery by means of a complete allergologic exploration.

2. Material and methods

2.1. Patients

A total of 204 adult patients of the department of abdominal surgery and 206 adult patients of the ORL department from the Ludwig Maximilians University of Munich were studied. All patients were evaluated preoperatively and were voluntarily involved in the study. Patients suffering from systemic diseases, allergic asthma, or are on

β -blocker, antihistaminic, or cortisone medication were excluded from participation in the examination. All patients agreed to participate in the study.

2.2. Questionnaire

Every patient answered a questionnaire (under supervision of the study staff), disclosing their symptoms concerning allergy (eczema, hay fever, rhinitis, nasal congestion, sneezing, cough), general medical information like number of preceding surgical interventions, hypersensitivity reactions to latex materials, tropical fruit, or hypersensitivity reactions in the household area, occupational information, smoking or drinking alcohol habits.

2.3. In vivo skin tests

The patients also underwent a skin prick test (SPT) with 5 commercially available NRL solutions (Hartmann, Regent, Bencard 1%, Bencard 5%, and Scherax). Because of lacking standardization within NRL solutions for SPTs, we performed the SPT with 5 different commercial extracts. Physiologic saline and histamine were served as negative and positive control mediums [2]. SPTs to the most common aero allergens (grass, birch, house dust mite, cat, dog, *Cladosporium*, *Alternaria*) were also performed.

2.4. In vitro tests

Total serum IgE and latex-specific IgE of all patients were quantified by radioallergosorbent test (RAST; UniCAP System, Pharmacia, Freiburg, Germany). Results of RAST in vitro tests were classified into 6 classes, where class 0 indicates absence and classes I to VI specify presence of latex-specific antibodies (IgE).

However, RAST is less sensitive than the in vivo SPT, but it can be used in a standardized way and is therefore safer than in vivo tests. Sensitivity varies between 50% and 90%, and specificity is reported between 80% and 97% [4], relative to SPT [11]. Its disadvantages consist of costs, lower sensitivity, and late results.

We defined NRL allergy as a product of a positive patient's history of symptoms to latex-containing materials and an NRL sensitization shown either in the SPT or/and in the RAST assay. Furthermore, we turned our attention to a patient's history of atopy.

Data were analyzed with SPSS (Microsoft). Fisher exact test and Wilcoxon Rank-Sum test were performed.

The study was approved by the ethics committee of the Ludwig Maximilians University of Munich.

3. Results

3.1. Patients, sex, age distribution

In spite of much information about latex allergy, there exist no data about prevalences of sensitization in different medicine disciplines. Therefore, we asked for prevalence rates and special risk factors of inpatients of the ORL

Table 2

Distribution of different CAP classes [12,32]

	IgE (kU/L)	ORL	Abdominal surgery
CAP class 0	<0.35	198	200
CAP class 1	0.35–0.7	3	1
CAP class 2	0.70–3.5	4	3
CAP class 3	3.5–17.5	1	0
CAP class 4, 5, and 6	>17.5	0	0

CAP class indicates the “capacity system” (UniCAP, Pharmacia) that defines amount of specific latex IgE.

department of the Ludwig Maximilians University hospital in Munich, Germany, in comparison with inpatients of the abdominal surgery department of the same hospital.

Of the 206 patients of the ear, nose and throat (ENT) department, 66 (32%) were women and 140 (68%) were men. Our data displayed a sex imbalance concerning NRL sensitization referring to men (16% sensitization of male patients vs 27% of female patients). The median age was 44 years (range, 25–72 years). Patients between 25 and 40 years were most frequently sensitized to NRL allergen (25%), among patients more than 65 years old, only 10% were positive in latex sensitization examination. Of 206 patients, 165 revealed neither a positive result in the SPT nor in the RAST in vitro diagnostics; thus, 80% of the patients cohort were not sensitized to NRL allergen. Of 206 participants in our study, 43 (20.9%) ranked with the NRL allergen-sensitized group, presenting in 33 cases a positive result in the SPT and in 10 cases a positive outcome in the RAST in vitro diagnostics (Table 2).

In Table 2, results of in vitro tests were graded into 6 classes, where class 0 of the in vitro IgE CAP system (UniCAP, Pharmacia) specifies absence, and classes I to VI denote presence of latex-specific antibodies (IgE) [12].

Two patients reported a history of immediate-type symptoms when dealing with latex products; thus, they were latex-allergic patients. Interestingly, one of them presented a positive reaction in neither the SPT nor the RAST in vitro diagnostics. An SPT reaction was considered positive after 20 minutes with a wheal ≥ 3 mm according to Dreborg et al [13]. Altogether, we found 43 (20.9%) of 206 patients of the

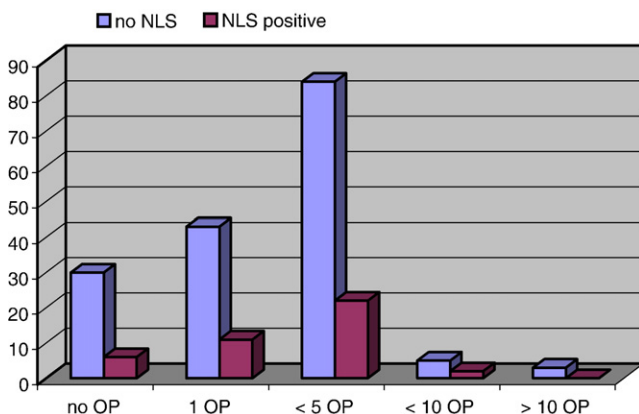


Fig. 1. Comparison between number of undergone surgical procedures and NRL in preoperative patients of the ORL department.

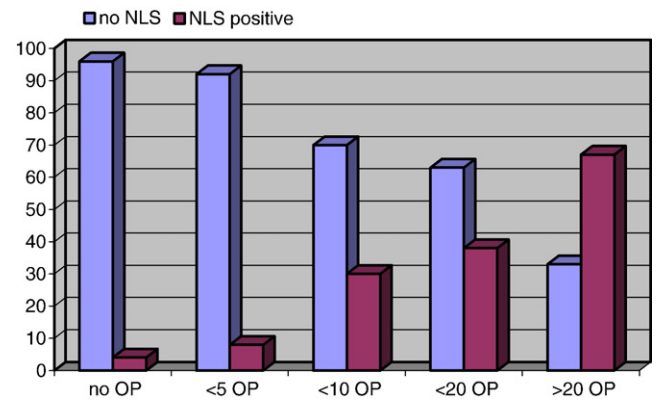


Fig. 2. Natural rubber latex sensitization in correlation with surgical procedures in the patients' medical history, department of abdominal surgery. OP indicates surgical procedures/operation; NLS, natural rubber latex sensitization.

ORL department sensitized to NRL allergen, with 2 (1%) of the 43 patients with symptoms of latex allergy.

From a total of 204 patients of the surgery department, 91 were women and 113 were men with a median age of 58 years (± 12.9 years). The maximum sensitization rate was measured within the 30- to 50-year-old patients (23%), whereas patients who were 70 year old were sensitized in 4.7%. We found a sensitization to latex allergen in 11 of 91 female patients (12.1%) and in 11 of 113 male patients (9.7%). Of this cohort, 19 (9.3%) demonstrated a positive reaction to NRL allergen in the SPT, one of them (0.5%) reported symptoms in association with latex products and was therefore considered to be allergic to NRL. Four patients (2%) presented NRL-specific antibodies in the serum. Totally, we evaluated 23 (11.3%) of 204 patients of the abdominal surgery clinic sensitized to NRL in our data, among them 1 patient (0.5%) manifested latex allergy.

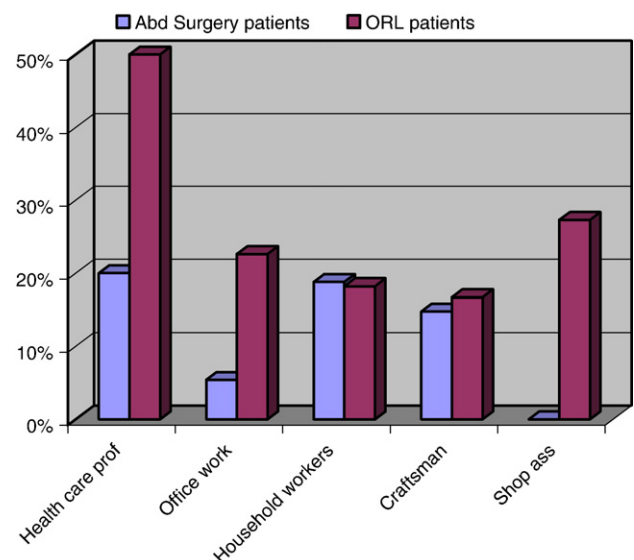


Fig. 3. Latex sensitization in patients with different professions. Y-axis indicates NRL sensitization in percent; x-axis, different professions.

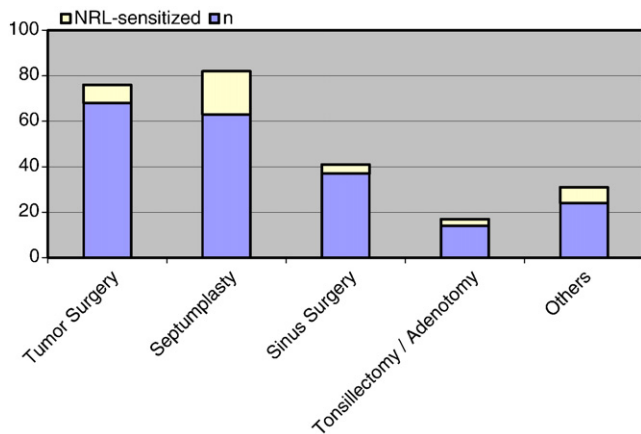


Fig. 4. Correlation between different ORL procedures and NRL sensitization. Y-axis indicates number of NRL-sensitized patients in relation to the total quantity; x-axis, intended surgical procedures to the patients of the ORL department.

3.2. Risk factors: multiple surgical procedures, atopy, high-risk work

In the ORL patients population, 36 (17%) did not have any prior surgical procedure, 54 patients (26%) undergone surgery once before, and 106 patients (51%) reported 2 to 5 invasive surgical interventions in their medical history. Three patients (1%) stated about more than 10 operations in the past (Fig. 1).

Within the abdominal surgery group, we found distributions referring to latex sensitization (Fig. 2).

In total, we found an elevated total IgE (>100 kU/L serum) in 20% of the patients. There were 36% of the NRL-sensitized patients and only 18% of the nonsensitized patients who presented increased IgE levels. In general, 21% of all patients with atopy in our study cohorts were sensitized to NRL. In the patients of the abdominal surgery department, we found 102 patients (50%) with atopic diathesis. Furthermore, it became obvious that patients with positive reactions in the SPT (ie, grass, birch, animals) were more susceptible for NRL sensitization than others.

Three patients who tested allergic against NRL allergen were working in hospital; therefore, they belong to the high-risk group of healthcare workers (Fig. 3).

In evaluating different intended surgical rhinolaryngological procedures concerning the distribution of NRL-sensitized patients, we divided all operative interventions in different groups: tumor surgery, rhino surgery, sinus surgery, and tonsillectomy/adenotomy (Fig. 4).

Our data revealed that nearly every third patient admitted to undergo septum surgery in the ORL department was sensitized to NRL.

4. Discussion

The aim of this project was to collect data concerning latex exposure and responses among ORL patients and

those of the department of abdominal surgery. We identified characteristics of risk groups and quantified prevalence rates among our study objectives to prevent patients from having severe systemic reactions and to minimize latex hypersensitivities in our clinical practice.

4.1. Diagnosis in latex sensitization

Diagnosis of latex allergy is based on a detailed clinical history and measurement of IgE sensitization to NRL [6]. We analyzed 2 cohorts of patients of the ORL department and abdominal surgery department of the Klinikum Großhadern, University of Munich, for NRL sensitization preoperatively. Four patients reported on manifest allergy symptoms in latex exposure: with shortness of breath, red rash, itching skin with bumps on contact areas, and even circulatory imbalances. We diagnosed a positive latex sensitization (NRL) in 21 (10%) of 204 abdominal surgery patients and in 41 of 206 (21%) ORL patients.

Surprisingly, we found a statistical rate of 21% within the ORL patients cohort, and here, we evaluate different risk factors and coherences responsible for this rate in our study results.

Some other studies referred to different prevalence rates in selected patient cohorts [14] or in volunteer blood donors [15]. Most information available in the literature are regarding 2 distinct populations that are particularly affected by latex allergy, healthcare professionals and children with spina bifida or other conditions making multiple surgeries necessary in early life [16,17]; hence, we tested ORL patients for several risk factors and predisposition.

Despite advances in the laboratory diagnosis, there exist no unique criteria for clear acknowledged diagnosis of a clinically manifested latex allergy. Regarding the guidelines of the European Academy of Allergology and Clinical Immunology, the SPT and provocation testing seem to be the most reliable methods of diagnostics in latex sensitization. In any case, a combination of clinical history and SPT should be used to diagnose latex allergy, except in those subjects reporting life-threatening reactions, in which in vitro specific IgE determination must be preferred [18]. In our opinion, patch testing with rubber chemicals should be reserved to selected cases.

In our settings, only 3% of the patients showed positive reactions to each of the different 5 test solutions, 25% were positive in 4 measurements, 17% in 3 measurements, 20% in 2 measurements, and 30% revealed a positive result in 1 of the 5 test solutions. Because of lacking standardization of the different solutions, different proteins react with epidermal and subcutaneous antigens leading to diverse examination results. Therefore, only patients sensitized against different latex allergens are able to react on different test solutions in a positive way. In this context, we observed a concrete correlation between an extent radius in the SPT and patients with solid symptoms when dealing with latex products. In this context, several other studies reported on these correlations before [15,19], we demand on

Table 3

Enumeration of various studies with several information regarding prevalence rates in NRL patients within/without high-risk groups

Author	Country	Cohort	Number	Method	NRL-sensitized (%)	Clinical symptoms (%)
Akasawa et al [33]	Japan	Nurses	601	RAST	9.7	0
Heese et al [34]	Germany	Students	206	SPT, RAST	8.7 4.9	5.4
Rueff et al [35]	Germany	Adult patients	325	SPT, RAST	4.9 7.1	1.2
Tarlo et al [36]	Canada	Students	203	SPT	10.0	17.0
Pittman et al [37]	Switzerland	Spina bifida	83	RAST	47	0.8
Fuchs [38]	Germany	Allergic patients	1288	SPT	4.20	3.00
Hadjiliadis et al [39]	Canada	Allergic patients	224	SPT	9.40	3.10
Reinheimer and Ownby [40]	USA	Patients	200	RAST	12.00	0
Laurent et al [41]	France	Women	121	SPT	4.10	?
Porri et al [17]	France	Preoperative screening	114	SPT	3.50	?
Turjanmaa and Makinen-Kiljunen [7]	Finland	Allergic patients	1089	SPT	1.10	

“?” indicates clinical symptoms were not mentioned in the study.

simultaneously testing several different test solutions to get a reliable result for the patient.

Radioallergosorbent test and AlaSTAT are the most common in vitro methods for diagnosis of latex sensitization [19,20]. Both techniques are less sensitive than the SPT, but they are more comfortable in their application form than the SPT, even for physicians and nurses who are not familiar to the SPT technique in their routine work.

In total, we found in 80% of the sensitized patients a positive result for latex antigen in the SPT, but only 15% of these individuals tested positively in the RAST, and only 5% got positive results in both methods. Hamilton et al [21] reported on similar observations in his study cohort, and established 25% patients who tested positively for NRL antigen in the SPT but not in the CAP system and the AlaSTAT technique. Possibly, we measured only low IgE concentrations in the patients' serum because of the very brief validity of IgE antibodies in the human serum and some cross-reactions between tropical fruit, vegetable, and latex antigen [22]. Leynadier and Dry [23] even account of an anaphylactic shock reaction observed intraoperatively in a patient who tested negative in the RAST method.

In the available literature concerning latex allergy and sensitization, we further noticed a problem in very diverse information regarding patients' prevalence rates due to application of different test methods (Table 3).

4.2. Age and sex

In the cohort of the ORL patients and the abdominal surgery patients, we found a significant correlation ($P = .001$) between a lower median age and a higher rate of NRL sensitization. The median age of ORL patients is about 44 years and about 58 years in the cases of the abdominal surgery patients. We saw maximal sensitization rates in the 30 to 50 year olds (23%) and the lowest in the individuals older than 70 years (4.7%). In our view, latex product quality wear off in the course of time, implying an elevated protein level in the latest latex products, therefore leading to more latex sensitization and allergies. In addition, it is obvious, that

the immune system response degenerates in old age, making immunological diseases such as allergies less probable.

Among both ENT and abdominal surgery patients, female sex may be a risk factor for latex sensitization in our data [24], and younger people were more likely to develop latex sensitization than older ones. The slightly higher NRL sensitization rate among women (12.1%) versus men (9.7%) is probably related to the elevated histamine secretion due to the female sex hormones [25]. Other literature quotation notes diverse information regarding NRL sensitization in sex distribution [26].

4.3. Risk factors for NRL sensitization

We already have much information about the context of multiple procedures and an elevated risk of developing NRL sensitization, especially in children with spina bifida [27]. Our results demonstrated in cases of the abdominal surgery patients a clear association between the numbers of prior surgical procedures and likelihood of NRL sensitization despite an inverse correlation between these parameters in ORL patients. Surgical interventions lead to intensive mucosal contact of latex proteins and subcutaneous tissue and run to a booster effect with an elevated production of specific antibodies. In cases of our ORL patients, this thesis may not explain the quite high sensitization rate in patients with less than 5 surgical procedures.

There also exists much literature about the context of atopic diathesis and NRL sensitization, putting atopic individuals in the risk group for latex sensitization [28]. In our data, patients with atopy were exceedingly represented in the positively tested group of sensitized patients (77% in the ORL patients cohort and 68% in the abdominal surgery cohort) because of their immunological tendency toward producing IgE antibodies against Coombs type I allergy proteins. The more we found atopic patients within a crowd, the more we quantified positive reactions to latex antigen.

It has been clear for several years that latex allergy occurs predominantly in certain high-risk groups, especially in

healthcare workers, infants with spina bifida, patients with multiple surgical interventions in their medical history, and immune-compromised individuals [4]. In our results, these details were proven: 3 allergic patients belonged to workers at risk, which are healthcare professionals, working at a hospital (Fig. 3). Baur et al [29] reported 2 cross-sectional studies on the relationships between objective measurements of airborne NRL allergens and risk of sensitization in German healthcare workers.

Many studies have evaluated the prevalence of NRL allergy in patients undergoing multiple surgical procedures, and spina bifida children often serve as an example of this “surgical” population [20,30,31]. It is supposed that medical devices may be the route of sensitization contact; therefore, we analyzed data of patients who underwent different otorhinolaryngological procedures, ruling out a special risk subgroup within our ORL patient population. We found patients admitted to undergo septum surgery overrepresented in the NRL sensitization group (30%), followed by patients planned for tonsillectomy or adenotomy (21%). A high percentage of patients were not assigned to a subgroup and were listed as “others” (29%). Looking at individual notes, patients with blocked nasal breathing and nasal disturbances addressed to our outpatient clinic for nasal surgery. Several times, allergy triggered these symptoms, and this may serve as an idea for the high percentage of sensitized individuals among the group of septoplasty patients.

5. Conclusion

Information about the exact etiology and progression of latex allergy is still missing. However, progression in medical research, rising knowledge about risk factors, and continuing education allow us to prevent more patients from probably life-threatening reactions in latex allergy. In our evaluation, the prevalence rates of NRL sensitization in ORL patients were also found in risk groups (21%); hence, one should take special care of these patients and inquire them directly regarding latex allergy symptoms preoperatively.

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