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Diagnosis of allergic rhinitis: inter-rater reliability and predictive value of nasal endoscopic examination: a prospective observational study

Diagnosis of allergic rhinitis

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Objective: To determine the inter-rater reliability of nasal endoscopic findings and the feasibility of diagnosis of allergic rhinitis based solely on symptoms and nasal endoscopy.

Design : Prospective observational study

Setting: University Teaching hospital

Participants: One hundred and eight patients were referred from the allergy clinic included in the study.

Main outcome Measures: Predictive value of symptoms and nasal endoscopic examination to diagnose allergic rhinitis and interrater reliability of the examination was evaluated.

Results: Logistic regression analysis of patient symptoms and nasal examination findings revealed no significant predictive power for any of the symptoms or examination findings.

The Fleiss κ coefficient of the three raters was calculated. Inter-rater variability among the three physicians demonstrated that mucosal edema ($\kappa = 0,48$, $p < 0.001$), polypoid degeneration of the inferior turbinate tail ($\kappa = 0.48$, $p = 0.01$), nasal polyps ($\kappa = 0.96$, $p < 0.001$), and nasal septal deviation ($\kappa = 0.65$, $p = 0.01$) showed significant inter-rater agreement. A low κ coefficient (0.29) was found, and the inter-rater variability among physicians in interpreting the characteristics of nasal secretions was significant ($p = 0.04$). The inter-rater variability among the three physicians suggested that turbinate hypertrophy ($\kappa = 0.31$) and turbinate color ($\kappa = 0.38$) showed no significant inter-rater agreement.

Conclusions: Patient symptoms and nasal endoscopy findings do not provide reliable diagnosis of allergic rhinitis. Turbinate color and hypertrophy are believed to be related to allergic rhinitis; however, these were subject to marked inter-rater variability in this study.

Rhinitis is an inflammatory condition of the nasal mucosa that consists of the following disorders: allergic, infectious, hormonal, drug-induced, occupational, and immunological disorders. Allergic rhinitis is both one of the most common types of rhinitis¹ and one of the most prevalent chronic conditions in the industrialized world. Moreover, it has a significant impact on the quality of life of sufferers.² Allergic rhinitis affects 10–20% of the global population.³

Physical examination and history may help the diagnosis of allergy. Turbinate hypertrophy, color of the turbinate mucosa, nasal secretion characteristics, nasal mucosa edema, presence of nasal polyps, and polypoid degeneration of the inferior turbinate tail are the physical properties associated with allergic rhinitis.

Skin prick tests (SPTs) are used in addition to physical examination and history to exclude or confirm IgE-mediated diseases such as allergic rhinitis and asthma. Wang *et al.* commented, “it is commonly felt by physicians that allergy testing does not alter the choice of treatment and there is no uniform understanding among physicians on the definition of AR based on nasal symptoms”. They also stated that, as a result of their relative non-availability and cost, allergy tests are not commonly (<50%) performed by general practitioners (GPs).⁴ In 2006, Civelek *et al.* conducted a questionnaire-based study of pulmonologists, pediatricians and GPs, and reported that only 52.9% of respondents utilized SPTs of whom only one-third examined the nasal mucosa.⁵

It has been stated that common nasal allergies can be diagnosed by a careful study of symptoms and the response to initial treatment.⁶ In contrast, Smith *et al.* commented that a structured history is not sufficient for diagnosis of allergic rhinitis, and SPTs improve the accuracy of assessment of allergic status based on solely patient opinion or a structured allergy history.⁷

History and nasal examination are important tools for diagnosis of allergic rhinitis.⁸ Physicians in primary and secondary healthcare settings tend to rely only on a history and nasal examination to diagnose allergy. However, nasal examination is subject to inter- and intraobserver variability, and patient history alone is not diagnostic of allergic rhinitis. In this study, we assessed the interobserver variability of nasal endoscopy, and assessed the value of patient symptoms and nasal endoscopic findings for diagnosis of allergic disease.

Materials and Methods

This study was conducted between February and September 2012 in İzmir Katip Çelebi University Atatürk Research and Education Hospital Otolaryngology Clinic. One hundred and eight consecutive adult patients with rhinitis who were referred from the Allergy and Asthma Clinic were included in the study. The patient group consisted of 36 males and 72 females, with a mean age of 33.8 ± 12.02 years.

Nasal endoscopy findings were evaluated independently by three physicians who were unaware of the patients' history and SPT results.. The nasal endoscopic examinations were performed with rigid nasal endoscopes. The nasal endoscopic images were recorded with a camera for documentation. White balance successfully performed for each evaluation in a consistent fashion. The following were excluded: patients using nasal steroids, antihistamines, or antileukotrienes 1 month prior to the evaluation; those with a history of endoscopic sinus surgery, septoplasty, or turbinate surgery; and patients with acute rhinosinusitis⁹. One hundred and eight patients were included in the evaluation. A physician who was blinded to the SPT results took patients' histories. These included the absence or presence of rhinorrhea, sneezing, itching, nasal obstruction, postnasal drip, smell dysfunction, cough, dysphonia, throat clearing, and smoking.

After nasal endoscopy, each physician documented the persistence of mucosal edema, inferior turbinate hypertrophy, turbinate color, polypoid degeneration of inferior turbinate tail, nasal polyposis, nasal secretion characteristics, and nasal septal deviation. Turbinate color was classified as pale or normal, and nasal secretions as serous/mucoid or absent. (Items were documented as present or absent)

All patients were tested with common aeroallergens using standardized extracts of Alk-Abello (Alk, Denmark) containing the following 27 allergen extracts: grasses (cocksfoot, meadow fescue, ryegrass, meadow grass, timothy, wheat, corn), weeds (mugwort, wall pellitory, plantain, goosefoot), trees (olive, birch, oak, alder, poplar, plane), mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*), molds (*Alternaria*, *Aspergillus*, and *Cladosporium* species), animal danders (cat, dog, budgie, duck, and chicken) and cockroach. Positive control (histamine phosphate 10 mg/mL) and negative control (saline) solutions were applied. Tests were read after 15 minutes. The largest and smallest diameters of the wheal and erythema were measured with a transparent millimeter ruler and summed. Results were recorded in millimeters as the mean value of the wheal and flare reactions. Erythema of at least 10 mm, a wheal 3 mm greater than the negative control was considered a positive response.

Ethical considerations

Written informed consent was elicited from every patient. İzmir Katip Çelebi Medical Faculty Ethics Committee approved the study. All the subjects were recruited on a voluntary basis.

Statistics

Statistical analysis was performed using SPSS version 16 and Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA, USA). The statistical significance level was

established at $p < 0.05$, and confidence intervals were 95%. Logistic regression analysis was used to determine the value of each history item to predict allergy. The Fleiss κ test was used to measure the inter-rater reliability among the physicians for each nasal endoscopic examination finding. The resulting κ values were indicative of the proportion of agreement greater than that expected by chance. The range of possible values of κ was from -1 to $+1$, although it usually fell between 0 (agreement that would be expected by chance) and 1 (perfect agreement). The interpretation of the κ coefficient was complex, because several factors can influence its magnitude or interpretation of a given magnitude.¹⁰ In the κ test, a $p < 0.05$ indicated that the agreement level was not due to chance alone.

Results

One hundred and eight patients were referred from the Allergy Clinic for evaluation. Five patients suffered from dermatographism. The nasal endoscopic examination findings of 103 patients were assessed with logistic regression. The frequencies of history items are presented in Table 1. The inter-rater reliability of the nasal examination findings of 108 patients was evaluated by Fleiss κ test. Physicians' assessments of nasal examination findings are presented in Tables 2–4. The sensitivity and specificity of the nasal endoscopic findings based on gender is presented in Table 5.

Forty-one patients (39.8%) had a negative skin test result. Sixty-two (60.1%) patients had a positive SPT(diagnosed as allergic rhinitis) . Multiple allergen sensitivity was identified in 45 (72.5%) patients and that to a single allergen in 17 (27.4%).

Logistic regression analysis demonstrated that none of the following history items had a significant predictive value for allergic rhinitis: rhinorrhea [odds ratio (OR) = 2.2, $p = 0.139$; sneezing (OR = 0.99, $p = 0.99$); itching (OR = 1.19, $p = 0.724$); nasal obstruction (OR

= 0.78, $p = 0.66$); postnasal drip (OR = 0.81, $p = 0.703$); smell dysfunction (OR = 0.57 $p = 0.232$); cough (OR = 0.85, $p = 0.74$); dysphonia (OR = 0.97, $p = 0.95$); throat clearing (OR = 1.31, $p = 0.62$); smoking (OR = 1.4, $p = 0.51$); and asthma (OR = 2.3, $p = 0.24$).

Inter-rater variability among the three physicians demonstrated that mucosal edema ($\kappa = 0.48$, $p < 0.001$), polypoid degeneration of inferior turbinate tail ($\kappa = 0.48$, $p = 0.01$), nasal polyps ($\kappa = 0.96$, $p < 0.001$) and nasal septal deviation ($\kappa = 0.65$, $p = 0.01$) showed significant inter-rater agreement. Although the κ coefficient (0.29) was low, the inter-rater variability among physicians in interpreting the characteristics of nasal secretions was significant ($p = 0.04$). The inter-rater variability among the three physicians indicated that the inter-rater agreements with regard to turbinate hypertrophy ($\kappa = 0.31$, $p = 0.28$) and turbinate color ($\kappa = 0.38$, $p = 0.06$) were not significant.

Low-moderate inter-rater agreement for nasal endoscopic findings makes it an unreliable predictor of allergic rhinitis and it was excluded from statistical analysis.

Discussion

Allergic rhinitis diagnosis is based upon concordance between a typical history of allergic symptoms and diagnostic tests. Immediate hypersensitivity skin tests are widely used to demonstrate an IgE-mediated allergic reaction and represent a major diagnostic tool in the field of allergy.¹¹ The high cost and restricted availability of allergic testing make use of identical diagnostic procedures in all regions of the world difficult.¹² Because of this limitations physicians in primary and secondary healthcare settings tend to rely only on a history and nasal examination to diagnose allergy. Our study introduces interrater reliability of nasal endoscopic examination with three raters and predictive value of both symptoms and nasal endoscopic examination with high number of subjects.

Comparison with other studies

Gendo and colleagues reported that symptoms could assist diagnosis of allergic rhinitis.¹³ They stated that diagnostic allergy testing is indicated if the test result could alter the decision to treat. Testing greatly affects diagnostic thinking when the suspicion is relatively low and does not particularly help when suspicion is high. They concluded that for patients with a convincing history of allergy, empirical medication as an initial step is reasonable. However, at this point controversy begins. Chaiyasate *et al.* investigated key nasal symptoms that predict a positive skin test in allergic rhinitis in 434 patients.¹² These symptoms included: nasal obstruction, rhinorrhea, itching, sneezing, and smell dysfunction. They concluded that no symptoms were predictive and reported no difference in the symptoms of patients with positive skin tests. Raza *et al.* investigated the inter-rater reliability of nasal physical examination and the value of directed history in 15 patients using three investigators.¹⁴ Each conducted a specific examination, formed a clinical impression, and then took a directed history to gain a second impression. The two impressions were then compared to skin testing. Results suggested that when history and examination findings were analyzed in combination, no individual variable was significantly different compared to skin testing in a multivariate analysis. When all history and examination items were assessed as physician impressions, the average sensitivity, specificity, positive predictive value, and negative predictive value of the history impression were higher than those of the examination impression. Also, none of the history items alone had significant predictive value for diagnosis of allergic rhinitis.

Physical examination items in allergic rhinitis are subject to marked inter-rater disagreement. Raza *et al.* evaluated the consistency of examination variables among raters and their value in prediction of allergic rhinitis.¹⁴ In their study, with the exception of the presence of nasal polyps, Fleiss κ values for inter-rater physical examinations were low, with

a score <0.5 for six of seven variables. Only detection of polyps showed almost perfect inter-rater reliability ($\kappa = 0.952$). In our study, only nasal polyps and nasal septal deviation had a highly significant value ($\kappa = 0.96$ and 0.65 , respectively). The κ values for mucosal edema, polypoid degeneration of inferior turbinate tail, and nasal secretion characteristics were each <0.5 , indicating low inter-rater agreement.

Ameli *et al.*¹⁵ evaluated the predictive value of endoscopic signs of allergic rhinitis in children. They described ‘turbinate hypertrophy’ as either inferior or middle turbinate contact, because turbinate hypertrophy is a frequent finding in allergic patients and thought to be related to allergic rhinitis. They stated that the heads of the inferior and middle turbinate is the first portion that frontally impacts with inspired airflow, thus it is particularly exposed to allergens and represents the site of local inflammation. They concluded that inferior and middle turbinate contact (with the lateral wall) is a reliable predictive factor for allergic rhinitis, whereas pale turbinates is not predictive. In our study, we found that the inter-rater agreement for turbinate hypertrophy was low, and neither turbinate hypertrophy nor color were not predictive of allergic rhinitis. We did not provide a detailed description of turbinate hypertrophy, in contrast to the report by Ameli *et al.* We aimed to demonstrate physicians’ understandings and interpretations of basic physical examination terms—such as turbinate hypertrophy—differ.

Strengths of the study

Most of studies conducted on diagnosis of allergic rhinitis based on questionnaires and patients symptoms. Only a few studies investigate the predictive value of nasal endoscopic findings. To our knowledge, this is the only study performed among a high number of subjects to demonstrate interrater reliability of nasal endoscopic findings.

Limitations of the study

We have demonstrated that inter-rater reliability of nasal endoscopic findings is low. Intra - rater reliability of these findings are also important and a structured history instead of single items and a scale with cut-off values for nasal endoscopic findings may increase accuracy to diagnose allergic rhinitis. It has been reported in a Turkish study that a SPT panel covering 12 allergen extracts (or less in adults,) was sufficient to cover at least 95% of the cases of SPT sensitization¹⁶. Our SPT panel did not include cypress pollens and dandelion which have 14,6 % and 58 % prevalence respectively¹⁷. If the specific allergen to which the patient was sensitive was not included, it would yield a false-negative result. Predictive value of patient history should be interpreted considering these facts.

Synopsis of the key findings

Allergic rhinitis is a common illness that decreases the quality of life of sufferers. Physicians in primary or secondary care centers tend to diagnose allergic rhinitis based on patient symptoms and a physical examination. Patients' symptoms and nasal examination findings are not reliable predictive tools for diagnosis of allergic rhinitis. Moreover, the nasal examination findings that are believed to be allergy related are subject to inter-rater disagreement.

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History	Present (n / %)	Absent (n / %)
Rhinorrhea	81(75 %)	27(25%)
Sneezing	98(90,7%)	10(9.3%)
Itching	76(70.4%)	32(29,6)
Nasal obstruction	89(82,4%)	19(17.6%)
Postnasal drip	66(61,1%)	42(38,9%)
Smell dysfunction	67(62%)	41(38%)
Cough	52(48.1%)	56(51.9%)
Dysphonia	39(36,1%)	69(63,9%)
Throat clearing	71(65,7%)	37(34,3%)
Smoking	25(23.1%)	83(76.9%)
Asthma	13(12%)	95(88%)

Table 1: A table showing frequency of history items

	Mucosal Edema						Turbinate Hypertrophy					
	Present			Absent			Present			Absent		
	1(n,%)	2	3	1	2	3	1	2	3	1	2	3
SPT +	41 (39.8)	22(21.4)	28(27.2)	21(20.4)	40(38.8)	34(33)	56(54.4)	38(36.9)	44(42.7)	6(5.8)	24(23.3)	18(17.5)
SPT -	26 (25.2)	18(17.5)	24(23.3)	15(14.6)	23(22.3)	17(16.5)	40(38.8)	31(30.1)	36(35)	1(1)	10(9.7)	5(4.9)

Table 2: Each physician 's assesment of mucosal edema and turbinate hypertrophy

	Turbinate Color						Polypoid degeneration of inferior turbinate tail						Nasal Polyposis					
	Pale			Normal			Present			Absent			Present			Absent		
	1(n,%)	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
SPT +	31 (30.1)	46(44.7)	45(43.7)	31(30.1)	16(15.5)	17(16.5)	1(1)	2(1.9)	5(4.9)	61(59.2)	60(58.3)	57(55.3)	8(7.8)	7(6.8)	7(6.8)	54(52.4)	55(53.4)	55(53.4)
SPT -	20 (19.4)	25(24.3)	34(33)	21(20.4)	16(15.5)	7(6.8)	0(0)	0(0)	0(0)	41(39.8)	41(39.8)	41(39.8)	1(1)	1(1)	1(1)	40(38.8)	40(38.8)	40(38.8)

Table 3: Each physician's assesment of turbinate color, polypoid degeneration of turbinate tail and nasal polyposis

	characteristics of nasal secretions						septal deviation					
	present (serous/mucoid)			absent			present			absent		
	1(n,%)	2	3	1	2	3	1	2	3	1	2	3
spt +	36 (35)	7(6.8)	20(19.4)	26(25.2)	55(53.4)	42(40.8)	44(42.7)	49(76.6)	46(44.7)	18(17.5)	13(12.6)	16(15.5)
spt -	17 (16.5)	8(7.8)	13(12.6)	24(23.3)	33(32)	28(27.2)	30(29.1)	34(33)	29(28.2)	11(10.7)	7(6.8)	12(11.7)

Table 4: Each physician's assesment of nasal secretion characteristics and nasal septal deviation.

Nasal endoscopic examination finding	Sensitivity			Specificity		
	Total	M	F	Total	M	F
Mucosal edema	67.6%	72%	65%	37.2%	63%	28%
Turbinate hypertrophy	90%	90%	92%	2.3%	9%	0
Turbinate color	49%	44%	52.5%	53%	72%	46.8%
Nasal polyposis	12%	12%	12.5%	95%	90%	96,5%
Nasal secretion	58%	68%	52,5%	58%	45%	62,5%
Polypoid inf. turbinate	1.5%	4%	0	100%	100%	100%

Table 5 : The sensitivity and specificity of the nasal endoscopic findings (M: male, F : female).

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