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Study of causal aeroallergens in allergic rhinitis

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ABSTRACT

Background: The diagnosis of allergic rhinitis requires a detailed history, thorough clinical examination and identification of aeroallergens by skin prick test. The diagnosis cannot be confirmed on the basis of symptoms alone because both allergic and non-allergic rhinitis can present with similar symptoms. The present study was undertaken to identify the common aeroallergens causing allergic rhinitis and to find any relationship of the severity of patient's symptoms with raised levels of absolute eosinophil count, percentage of eosinophils in the peripheral blood and total serum IgE.
Methods: It is cross sectional study was conducted among 100 patients including both the genders attending out-patient department of ENT. The patients were divided into mild, moderate and severe disease categories based on nasal symptom score (NSS) which was calculated taking into account the severity of four symptoms namely sneezing, watery rhinorrhoea, itching sensation in nose and nasal obstruction.
Results: 76% of patients had moderate nasal symptom score and 42% had symptoms of allergic rhinitis for less than 3 years. The prevalence of skin prick test was strongly positive for pollens (46.19%), followed by dust (16.4%), dust mites (15.7%), fungus (9.7%), insects (9.24%) and epithelia (2.77%). But, among 68 aeroallergens, most common offending allergen was D-farinae (30%). There was no significant relationship found to exist between Eosinophilia, Absolute eosinophil count and serum IgE level with that of nasal symptom score.
Conclusions: Skin prick test is the gold standard investigation of choice for definitive diagnosis of allergic rhinitis.

Keywords: Allergic rhinitis, Skin prick test, Absolute eosinophil count, Total serum IgE, Nasal symptom score, Eosinophils, Allergens

INTRODUCTION

Allergic rhinitis (AR) is an inflammatory condition of the nasal mucosa, caused by immunoglobulin E (IgE) mediated early phase and late phase hypersensitivity responses, usually to inhalant allergens and a classical symptom complex consisting of sneezing, nasal congestion, nasal itching and rhinorrhoea.[1,2] AR is one of the most common chronic diseases worldwide, affecting 10-30% of adults and up to 40% of children.[3] In India, the prevalence of AR is 20-26%.[4] It has a significant effect on quality of life (QOL), if left untreated.

Many factors including inhaled, ingested or contact allergens can trigger off nasal allergy. Exposure to the various aeroallergens plays an important role in pathogenesis of AR. Many studies have shown that the distribution and pattern of aeroallergens is significantly different in different countries and even in different parts of a country. The distribution and pattern of aeroallergens differ depending upon the geographic regions, temperature and climate. Moreover, for an efficient diagnosis and treatment, it is important to have knowledge of sensitization and to identify the common aeroallergens in that particular area.[5,6] The main sources

of allergens are dust mites, moulds, pollens, pets and insects. AR can be classified as perennial, seasonal and episodic. Alternatively, allergic rhinitis and its impact on asthma (ARIA) suggest categorizing AR as intermittent or persistent depending upon the duration of symptoms and severity of disease.[7]

AR often coexists with other disorders such as asthma, otitis media, Eustachian tube dysfunction, nasal polyps, sinusitis, allergic conjunctivitis and atopic dermatitis. A variety of tests and clinical allergy markers have been utilized to differentiate between allergic and non-allergic rhinitis. Skin prick test (SPT) is the standard tool for routinely identifying sensitizing allergens for AR. It has been found to be more sensitive and specific test for the assessment of specific IgE. Serum IgE levels assess sensitization as well as exposure to environmental antigens and is frequently used to determine the prevalence of allergic responsiveness.

Keeping in view the rising incidence of AR and its effect on the quality of life and the stereotyped treatment often given for all cases, this study aims to identify the parameters that help to diagnose and differentiate the types of rhinitis.

Aims and objectives

In our study, we aim

- To identify various allergens in patients by skin prick test (SPT) that give rise to allergic rhinitis.
- To correlate severity of AR with-
  - Raised blood eosinophils percentage in the peripheral blood,
  - Raised absolute eosinophil count,
  - Raised total serum IgE level.

METHODS

It was a cross-sectional study conducted in total 100 subjects from both the genders in the age group of 10-60 years with symptoms of allergic rhinitis from August 2017 to June 2018 in the Department of ENT and Head and Neck Surgery, Northern Railway Central Hospital, New Delhi with the approval of Scientific and Ethical Committee.

Inclusion criteria

Patients with classical symptoms of allergic rhinitis such as sneezing, watery rhinorrhoea, nasal itching and nasal congestion.

Exclusion criteria

Patients with active upper respiratory infection, fever, uncontrolled asthmatics, invasive fungal sinusitis, immunodeficiency status, severe eczema or dermatographism, users of beta blockers, current users of oral antihistamines and steroids (that need to be stopped 5-7 days prior to skin prick testing) and pregnant woman.

A detailed history was taken and complete ENT examination including anterior rhinoscopy, diagnostic nasal endoscopy, otoscopy and 70-degree endoscopy for pharyngeal and laryngeal examination was performed on all the patients. They were asked to grade each of their nasal symptoms, namely sneezing, watery rhinorrhoea, nasal itching and nasal congestion as none (0 points), mild (1 point), moderate (2 points) and severe (3 points). The arithmetic sum of these was referred as the nasal symptom score (NSS) and the severity was classified as severe for a score of 9-12, moderate for a score of 5-8, mild for a score of 1-4 and nil for a score of zero. All patients were than subjected to the following tests-

- Peripheral blood smear sample was sent for measurement of eosinophils by differential count and absolute eosinophil count. The percentage of eosinophils of upto 5 and absolute eosinophil count of up to 440 cells/mm^3 was taken to be normal.
- *Total serum IgE level:* It was measured by ELISA and chemiluminescent assay. The upper limit of normal was taken as 150 IU/ml.
- *Skin prick test (SPT):* The patients were tested for 68 aeroallergens manufactured by Creative Diagnostic Medicare Private Limited, Navi Mumbai (CREDISOL). The tests were performed according to standard methods with allergens. Glycerinated buffered saline is used as a negative control and histamine diphosphate or dichloride was used as a positive control. The skin prick reaction was read after 15-20 minutes and considered positive if the reaction wheal diameter was at least 3mm larger than negative control.

Statistical testing was conducted with the statistical package for the social science system (version SPSS 17.0). Continuous variables will be presented as mean±SD. Categorical variables were expressed as frequencies and percentages. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

RESULTS

In our study, though age of patients ranged from 10-60 years, majority of patients were in the age group of 31-40 years (31%) with male to female ratio of 1.5: 1. Out of 100 patients, 42% were suffering from the problem of allergic rhinitis for less than 3 years. 18% had past history of bronchial asthma, 15% had food allergy, 8% had a history of childhood allergy, 31% had family history of allergy, 7% underwent nose and paranasal sinus surgery and 3% had a history of drug allergy.

The most common allergen/ irritant causing aggravation of symptoms was dust, which was responsible for 97% of cases, followed by smoke (22%) and the least was pollen (5%). Out of 100 patients with symptoms of allergic rhinitis, 72% had a history of episodic symptoms, 23% of patients had complaints of aggravation of symptoms on change in season, while 19% of patients had symptoms throughout the year. Most patients (76%) had nasal symptom score between 5-8 with a mean of 5.99 and standard deviation of 1.56.

The prevalence of skin prick test was strongly positive for pollens (46.19%), followed by dust (16.4%), dust mites (15.7%), fungus (9.7%), insects (9.24%) and epithelia (2.77%). But among 68 aeroallergens, most common offending allergen was D-farinae (30%).

Amongst dust mites, D-farinae (30%) was the most common indoor aeroallergen showing positive reaction with SPT followed by D- pteronyssinus (23%) and Blomia (15%).

Table 1: SPT positive patients for fungi.

SPT (FUNGI)	Percentages (%)
Aspergillus fumigates	7
Aspergillus niger	7
Aspergillus flavus	3
Fusarium solanii	6
Rhizopus nigricans	2
Aspergillus tamarii	2
Curvularia lunata	1
Pencillium species	0
Cladosporium herbarum	2
Alternaria alternate	5
Candida albicans	1
Tricoderma species	3
Phoma tropicalis	2
Helminthosporium	0
Aspergillus versicolor	1

Amongst fungi, *Aspergillus fumigates* (7%) and the *Aspergillus niger* (7%) were the most common offending allergens, followed by *Fusarium solanii* (6%), *Alternaria alternate* (5%). The least common fungi were *Curvularia lunata* (1%), *Candida albicans* (1%) and *Aspergillus versicolor* (1%). The same results have been represented in Table 1.

Amongst pollens, *Chenopodium album* (18%) was the most common allergen showing significant positive SPT followed by *Parthenium hysterophorus* (14%), *Amaranthus spinosus* (13%), *Chenopodium murale* (11%), *Ipomoea* species (11%) and the same results have been shown in Table 2.

Grain dust wheat (17%) was found to be the most common allergen amongst group dust followed by grain dust rice (9%), cotton dust (9%), and spider web dust (8%) and the same results have been represented in Table 3.

Table 2: SPT positive patients for pollen.

SPT (pollen)	Percentages (%)
Cynodon dactylon	6
Cyperus rotundus	5
Parthenium hysterophorus	14
Ischaemum	9
Amaranthus spinosus	13
Argemone mexicana	6
Chenopodium album	18
Xanthium strumarium	8
Brassica nigra	8
Ageratum conyzoides	7
Cocos nucifera	1
Peltophorum pterocarpum	1
Eucalyptus species	3
Ricinus communis	7
Cassia siamea	2
Zea mays	5
Typha angustata	3
Acacia arabica	3
Prosopis juliflora	8
Chenopodium murale	11
Carica papaya	7
Putranjiva roxburghii	4
Holoptelea integrifolia	3
Ailanthus excels	5
Casuarina equisetifolia	5
Ipomoea species	11
Cenchrus barbatus	8
Azadirachta indica	6
Mangifera indica	2
Samania saman	8
Pithocellibium	3

Table 3: SPT positive patients for dust.

SPT (dust)	Percentage (%)
Wheat dust	5
Cotton dust	9
House dust	7
Paper dust	2
Hay dust	3
Saw dust	3
Polished dust	4
Grain dust rice	9
Grain dust wheat	17
Spider web dust	8
Silk dust	4

Amongst epithelia, pigeon droppings (4%) was the most common allergen showing significant positive skin reaction, followed by dog epithelia (3%), sheep wool (3%) and pigeon feather (2%).

Mosquito (15%) was found to be the most common allergen amongst group insects followed by rice weevil (10%), cockroach (8%) and moth (7%).

The above table shows that absolute eosinophil count (AEC) was >440 cells/mm^3 in 50% of patients. The minimum count was 44 cells/mm^3 and the maximum count was 1790 cells/mm^3. P value was 0.881 and there was no statistically significant difference between AEC and NSS.

Table 5 reveals that 49% of patients had raised eosinophils percentage in their peripheral blood smear. No relationship was found between NSS and E%.

Table 4: Correlation of absolute eosinophil count (AEC) with nasal symptom score (NSS).

		Nasal symptom score			Total	Pearson Chi-square	P value
		Mild	Moderate	Severe			
AEC cells/cu mm^3	Normal (≤440)	9	39	2	50	0.253	0.881
	Raised (>440)	11	37	2	50		
Total		20	76	4	100		

Table 5: Correlation of blood eosinophils (E)% with nasal symptom score (NSS).

		Nasal symptom score			Total	Pearson Chi-square	P value
		Mild	Moderate	Severe			
E%	Normal (≤5)	10	40	1	51	1.171	0.557
	Raised (>5)	10	36	3	49		
Total		20	76	4	100		

Table 6: Correlation of total serum IgE level with nasal symptom score (NSS).

		Nasal symptom score			Total	Pearson Chi-square	P value
		Mild	Moderate	Severe			
IgE IU/ml	Normal(≤150)	8	24	0	32	2.477	0.29
	Raised(>150)	12	52	4	68		
Total		20	76	4	100		

The above table shows that the total serum IgE level was greater than 150 IU/ml in 68% of patients. The minimum recorded value was 3 IU/ml and the maximum was 3000 IU/ml. P value was 0.29 and no relationship was found to exist between serum IgE level and NSS.

DISCUSSION

Aeroallergens are the prominent cause of allergic symptoms in patients with allergic rhinitis. Different types of environmental aeroallergens are known to play a role in triggering or exacerbating allergic rhinitis. Identification of the most prevalent aeroallergen in each area has a very important role in diagnosis and treatment of allergic rhinitis.

The skin prick test (SPT) is the recommended initial investigation to find out the offending aeroallergens. Atopy is a very important risk factor for bronchial responsiveness and allergens can be precipitating factors even for sudden respiratory arrest. Hence, identification of specific allergens is valuable for diagnosis and treatment of allergic rhinitis and asthma. It provides faster results when compared to radio allergo sorbent testing (RAST).

In our study, the most common offending allergen group was pollen (46.19%) followed by dust (16.4%), dust mites (15.7%), fungus (9.7%), insects (9.24%) and epithelia (2.7%). This could be due to our study population living in close proximity of railway tracks, farm lands, meadows and areas of wild weeds. Moghtaderi et al, showed that pollens (64.6%) are the most common type of aeroallergens followed by dust mites (34.6%), cockroach (30.6%) and fungi (16%).[8] Roohi et al, also found pollen (48%) to be the most common allergen in patients with rhinitis.[9] The patterns of aeroallergens in the environment differ widely in different localities and also change from one season to another. Chandika and Deb et al, showed that sneezers-runners had significantly more sensitization to pollens while blockers had more sensitization to polyvalent house dust mites and fungi.[10,11]

Few Indian studies reported contrasting findings to ours. The study done in Allahabad, Uttar Pradesh on a relatively smaller cohort (50 patients) showed dust mite (78%), followed by dust (66%), and insects (44%), as the implicated antigens.[12] Prasad et al, showed markedly positive skin reaction to various dusts and the most common dusts identified were house dust (25%), wheat dust (12.5%), cotton dust (6.3%) and paper dust (4.2%).[13]

This difference in various studies could be due to differences in geographic regions where the study was conducted because the allergens depend on the environmental factors and vary from place to place.[14]

In our study, most common individual offending aeroallergen was dust mite (D-farinae). In a similar study, Farrokhi et al, demonstrated house dust mites (88.5%) were the most common aeroallergens followed by molds (80.7%), animal dander (77.5%), weeds and trees (73.3%) and grass pollen (67.9%).[15] Most of SPT positive patients were reactive to two or more allergens showing multi-allergen sensitization. It may be due to several factors, such as cross reactivity among allergens belonging to close reservoirs, which reflects the presence of common allergenic epitopes in different but botanically close plant species, long term exposures to close phylogenic source of allergens and interactions of genetic and environmental factors.

We compared the percentage of blood eosinophils, absolute eosinophil count and total serum IgE with the severity of the clinical score. General belief is that severity of AR is associated with raised blood eosinophils and AEC, but such findings were not demonstrated in our study. Chowdary et al, also found that more than 90% of patients with AR had blood AEC<440 cells/cumm.[16] The total serum IgE level also did not correlate with the severity of nasal symptoms but the level was raised in 68% of patients which was statistically significant.

Patel et al, conducted a prospective study on 70 patients and concluded that there was no correlation of blood AEC with severity of clinical score and majority (94.29%) of the patients had no eosinophilia.[17] Bellamkonda et al, observed normal AEC was found in 55% of cases and raised AEC was seen in only 45% of cases implicating that AEC was not raised in more than half the allergic rhinitis patients.[18]

Karli et al, investigated the correlation of patients having allergic rhinitis symptoms with the total serum IgE level and found out that 38.3% of cases had IgE values <100 IU/ml and results of total IgE could not be obtained in 4.06% of cases.[19] So, they concluded that determination of IgE in allergic rhinitis is a supportive parameter and cannot be recommended for routine use owing to its high cost and the time taken to perform the test. Elevated total IgE levels are usually associated to allergy but it also depends on various other factors such as parasite infestations, smoking, pollution, local diet and different genetic background.

CONCLUSION

In our study, we found pollen as the overall most common offending allergen group (46.19%), whereas the most common indvidual offending aeroallergen was dust mite (D-farinae). We have concluded that skin prick test is the gold standard investigation of choice for definitive diagnosis of allergic rhinitis and it is mandatory to identify the allergens by skin prick test for considering the patients for immunotherapy. The diagnosis and severity of allergic rhinitis does not depend on the raised levels of eosinophils %, absolute eosinophil count and total serum IgE. Finally, allergic disorders are on the rise and have a significant impact on the quality of life. So, treatment should focus on allergen identification, avoidance, medications and immunotherapy.

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