

Determination of Serum IgE and Eosinophils as a Diagnostic Indicator in Allergic Rhinitis

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Abstract Allergic Rhinitis is a chronic, inflammatory disease induced by an IgE-mediated reaction and identified clinically by the presence of symptoms of nasal discharge, itching, sneezing and nasal congestion. The aim and objectives of the study was to determine serum IgE and eosinophil levels in patients with allergic rhinitis and healthy controls, men and women, different age groups and to establish a correlation between serum IgE and eosinophil. A retrospective study was conducted in the outpatient department of ENT in ICARE institute of medical sciences and research, Haldia during the time span of March 2016 to February 2017. A total of 155 subjects (113 cases and 42 controls, 74 men and 81 women) of age 1 month—

75 years were selected for the study. Blood samples obtained were analyzed to determine serum IgE and eosinophil levels and the results were subjected to statistical analysis using STATA 12 software. The mean values and standard deviation of the serum log IgE and eosinophil levels in cases and healthy controls, men and women, various age groups were obtained and tabulated using paired *t* test and MV test. Pearson's correlation was performed to establish a relationship between serum log IgE and eosinophil levels. The mean values of serum log IgE and eosinophil levels were found to be higher in cases (log IgE—5.65, IgE—814.36 IU/ml, eosinophil—4.49%) when compared to controls (log IgE—4.43, IgE—96.62 IU/ml, eosinophil—2.36%). Men predominance was seen in mean serum log IgE levels (IgE—1018.5 IU/ml, log IgE—5.92) whereas women predominance in mean eosinophil counts (4.96%) in allergic rhinitis. A weakly positive correlation of 0.194 was established between serum log IgE and eosinophil levels. Estimation of serum IgE and eosinophil can serve as a simple, non-invasive and reliable investigative tool in the diagnosis of allergic rhinitis.

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Introduction

Allergic rhinitis is the most common increasing allergic respiratory disorder affecting 10–20% of the population [1]. The term allergy was coined by Clemens Vonpirquet from Greek word “allos” meaning “others” and “ergon” meaning reaction to describe hypersensitivity reaction in 1906 [2]. Allergic rhinitis is an immunoglobulin E (IgE) mediated hypersensitivity disease of mucous membrane of

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nasal airway characterized by sneezing, itching, watery nasal discharge and sensation of nasal obstruction. Severe conditions have been associated with considerable impairments in quality of life, sleep and work performance [1, 3].

In allergic rhinitis, numerous inflammatory cells including mast cells, CD4+ T cells, B cells, macrophages and eosinophils infiltrate the nasal lining upon exposure to an inciting allergen (most commonly airborne dust mite fecal particles, cockroach residues, animal dander, moulds and pollens). The T cells infiltrating the nasal mucosa are predominantly T helper 2 in nature and release cytokines (e.g., interleukin IL-3, IL-4, IL-5, and IL-13) promoting IgE production by plasma cells which, in turn, triggers the release of mediators, such as histamine and leukotrienes responsible for arteriolar dilation, increased vascular permeability, itching, rhinorrhea, mucous secretion and smooth muscle contraction. Furthermore, they trigger a cellular inflammatory response over the next 4–8 h resulting in recurrent symptoms [1, 3].

IgE determination plays a vital role in the diagnostic assessment of patients with established or suspected allergic diseases, asthma, allergic rhinitis, eczema, urticaria, atopic dermatitis and some parasitic infections [4, 5]. Eosinophilia is a hallmark sign of allergy, asthma, parasitic diseases, granulomatous disorders, fibrotic conditions and several malignant tumors [5].

Estimation of serum IgE and eosinophil levels can serve as a simple, economical and reliable investigative tool in the diagnosis of allergic rhinitis [1, 2]. Considering the above background, the aim and objectives of the present study was to determine serum IgE and eosinophil levels in patients with allergic rhinitis and healthy controls, men and women, of different age groups and establish a correlation between serum IgE and eosinophil.

Materials and Method

A retrospective study was conducted in ICARE institute of medical sciences and research, Haldia, West bengal during the time span of March 2016 to February 2017. The study was initiated after procuring approval for the protocol by the Institutional Ethical Committees. A total of 155 subjects belonging to both genders (113 cases and 42 controls, 74 men and 81 women) of age 1 month–75 years attending the outpatient department of ENT were selected for the study. The subjects were divided into three age groups: Group 1 (1 month–25 years), Group 2 (26–50 years) and Group 3 (51–75 years).

Patients were diagnosed as allergic rhinitis based on ARIA guidelines. According to these guidelines, allergic rhinitis is defined if two or more symptoms of rhinorrhea,

nasal itching, nasal blockage or sneezing is present in a patient for at least one hour per day for 4 days or more a week and also for 4 or more weeks a year [1]. Subjects with history of nasal or craniofacial surgery within 30 days, active infections or history of worm infestations for past 3 months, any underlying systemic chronic illnesses were excluded from the study. Healthy subjects without any systemic illnesses were considered as controls. The importance and need for the study were explained to all the participants and informed consent obtained. The history, clinical features and investigations performed were noted in a proforma especially designed for the study.

With strict aseptic precautions, blood sample was drawn from all subjects by venepuncture from the antecubital fossa and 3 ml of blood collected in EDTA anticoagulant. The blood samples were analyzed to determine serum IgE and eosinophil levels. Serum IgE was estimated by fully automated bidirectionally interfaced chemiluminescent immunoassay and eosinophil count by hematology analyzer, Sysmex Japan. Serum IgE was measured in terms of IU/ml and eosinophil as %.

The results obtained were subjected to statistical analysis using STATA 12 software. Due to the high variance of serum IgE levels, natural logarithmic transformation of IgE was done and results evaluated. The mean values and standard deviation of the serum log IgE and eosinophil levels in cases and healthy controls, men and women, various age groups were obtained and tabulated using paired t-test and MV test (multiple-sample multivariate test). The mean differences were also calculated for the same and 95% confidence intervals evaluated. Pearson's correlation was then performed to establish a relationship between serum log IgE and eosinophil levels. To test the robustness of our analysis, we had winsorized the data at 99% level and re-evaluated. Significance level was based on p value < 0.05 .

Results

A total of 155 subjects (113 cases and 42 controls, 74 men and 81 women) with mean age of 33.21 years were included in the study. The mean log IgE in cases and controls were 5.65 (IgE—814.36 IU/ml) and 4.43 (IgE—96.62 IU/ml) respectively which was statistically significant with p value of < 0.001 . The mean eosinophil in cases and controls were 4.49 and 2.36% respectively which was also statistically significant with p value of 0.0005 (Table 1).

The mean serum log IgE was found to be higher in men (log IgE—5.92, IgE—1018.5 IU/ml) when compared to women (log IgE—5.39, IgE—627.48 IU/ml) and was statistically significant (p value—0.033). The mean eosinophil

Table 1 Higher serum log IgE and eosinophil levels in cases when compared to controls

	Group	No	Mean	SD	95% confidence interval	<i>p</i> value
Log IgE	Controls	42	4.43 (96.62) ^a	0.54	4.257–4.594	< 0.001
	Cases	113	5.65 (814.36) ^a	1.54	5.365–5.938	
Eosinophil (%)	Controls	42	2.36	1.23	1.975–2.739	0.0005
	Cases	113	4.49	4.04	3.733–5.241	

^aDenotes arithmetic mean of IgE in IU/ml

was found higher in women (4.96%) when compared to men (3.96%) with *p* value of 0.094 (Table 2).

The mean serum log IgE was found to be higher in group 1 (log IgE—5.8, IgE—999.61 IU/ml) followed by group 3 (log IgE—5.7, IgE—781.25 IU/ml) and group 2 (log IgE—5.55, IgE—729.69 IU/ml) which was statistically insignificant (*p* value—0.762). The mean eosinophil was found to be higher in group 2 (4.79%) followed by group 3 (4.22%) and group 1 (4.03%) which was also statistically insignificant (*p* value—0.659) (Table 3).

A weakly positive correlation of 0.194 was found between serum log IgE and eosinophil which was statistically significant with a *p* value of 0.0152 (Fig. 1).

Discussion

Allergic rhinitis is a common allergic disease with increasing prevalence generally developing during childhood and particularly affecting teenagers and young adults. It has been anticipated that up to 90% of patients are untreated, inadequately or inappropriately treated [6]. A thorough history and physical examination are the cornerstones of establishing the diagnosis of allergic rhinitis. Estimation of serum IgE and eosinophil level is also considered as a valuable diagnostic parameter [1, 3, 5].

Allergy involves the production of a special class of antibody called IgE which are bound to specific cells called mast cells found in the skin, lungs and many other tissues. IgE plays an imperative role in allergy and is associated with type I hypersensitivity [4]. The serum level of IgE is 0.0003 mg/ml, the lowest of all other types of antibodies

and is capable of triggering the most powerful immune reactions [5]. Variations in the upper limit of normal total serum IgE have been reported to be 150–1000 IU/ml, but the usually accepted upper limit is 150–300 IU/ml. This variation is also seen in the present study which may be probably related to a different technique used for measuring IgE and different populations investigated [7].

The skewed distribution of IgE observed in the present study had made it necessary to convert them from arithmetic to logarithmic values in reporting group means and ranges. Secondly, winsorizing the data at 99% level for IgE was done. The advantage of winsorizing the data is that in a winsorized estimator, the extreme values are instead replaced by certain percentiles (in our case 99%), henceforth no data is excluded. In our study, the reference serum IgE level ranged from 0.5 to 393 IU/ml and < 158 IU/ml in adults. Higher serum IgE levels were observed in cases (814.36 IU/ml) when compared to healthy controls (96.62 IU/ml) in our study. These results were in accordance with studies conducted by Tegnoor et al. [6], Demirjian et al. [8], Paula Couto et al. [9], Brakhas et al. [10], Al-Rabia [11] and Corsica et al. [12].

Age and sex relationship also exists with regard to serum IgE. The peak levels of women are reached during the latter half of the first and beginning of the second decade, then declines thereafter reaching a low level in subjects > 75 years. Men have higher levels than women at any given age [14]. Men predominance was evident in the present study which was consistent with studies conducted by Tegnoor et al. [6], Paula Couto et al. [9] and Brakhas et al. [10]. In contrary, Shoormasti et al. [7] and Al-Rabia [11] observed higher serum IgE levels in women.

Table 2 Higher serum log IgE levels in men whereas eosinophil levels higher in women

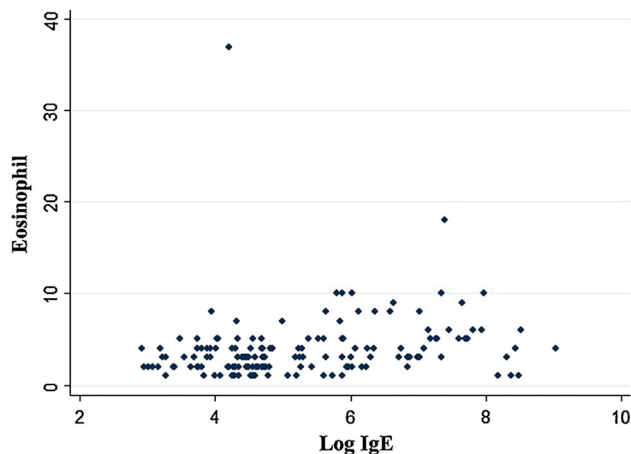
	Group	No	Mean	SD	95% confidence interval	<i>p</i> value
Log IgE	Men	54	5.92 (1018.5) ^a	1.50	5.515–6.338	0.033
	Women	59	5.39 (627.48) ^a	1.53	4.999–5.797	
Eosinophil (%)	Men	54	3.96	2.18	3.367–4.558	0.094
	Women	59	4.96	5.17	3.618–6.314	

^aDenotes arithmetic mean of IgE in IU/ml

Table 3 Comparison of serum log IgE and eosinophil levels in various age groups shows no statistical significance

Age group	Group 1	Group 2	Group 3	<i>p</i> value
No of cases	32	63	18	
Mean log IgE	5.8 (999.61) ^a	5.55 (729.69) ^a	5.7 (781.25) ^a	0.762
Mean eosinophil (%)	4.03	4.79	4.22	0.659

^aDenotes arithmetic mean of IgE in IU/ml

**Fig. 1** A weakly positive correlation seen between serum log IgE and eosinophil in patients with allergic rhinitis

The level of IgE is low during the first year of life, gradually increases with age and reaches adult age after 10 years. Aging is associated with modifications of the immune system contributing to a reduce prevalence of allergic diseases in elderly population [10, 12]. In the present study, mean IgE levels ranged up to 999.61 IU/ml in the younger age group, 729.69 IU/ml in group 2 and 781.25 IU/ml in group 3. As we had observed such colossal variation in younger as well as elder ages, groups were divided accordingly. Although, the results of the mean log IgE levels were statistically insignificant, group 1 (0.1–25 years) observed higher levels. This was in agreement with Shoormasti et al. [7], Demirjian et al. [8], Paula Couto et al. [9] and Meena et al. [13].

Eosinophil is recognized as a pro-inflammatory granulocyte implicated in protection against parasitic infections and plays a vital role in allergic diseases such as bronchial asthma, allergic rhinitis and atopic dermatitis. They also induce inflammation by releasing lipid mediators, oxygen metabolites and cytokines resulting in increase in vascular permeability. The normal range of eosinophil is 0–6% but this range may vary slightly in different laboratories [5, 15]. 1–6% of eosinophil count was considered as the reference range in the present study. Higher eosinophil count was found in patients with allergic rhinitis (4.49%) compared to controls (2.36%). These results were

consistent with Sonawane et al. [2], Demirjian et al. [8] and Brakhas et al. [10]. A weakly positive correlation was found between serum log IgE and eosinophil levels in patients with allergic rhinitis which was also evident in study conducted by Brakhas et al. [10].

However, there were certain limitations in the present study. Although a thorough history and physical examination are required to establish the clinical diagnosis of allergic rhinitis, further diagnostic testing is usually essential to confirm that underlying allergies causing rhinitis. No measures could be taken for specific IgE or skin prick test in our study which is the gold standard in the diagnosis of allergic rhinitis.

Conclusion

Allergic sensitization mediated by IgE and eosinophils is the basis of allergic diseases. Serum IgE and eosinophil count can be considered as an easy, non-invasive, economical and dependable preliminary diagnostic criterion in patients with allergic rhinitis so that appropriate treatment can be planned. In the present study, elevated serum IgE and eosinophil levels were observed in patients with allergic rhinitis with predominance in men and younger age group. A weakly positive correlation was also established between serum IgE and eosinophil evocative of their substantial role in allergic rhinitis.

Compliance with Ethical Standards

Conflict of interest The authors declare that there is no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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