RESEARCH ARTICLE

A comparative study of eosinophil count in nasal smear and peripheral blood smear in allergic and non-allergic rhinitis patients

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ABSTRACT

Background: Allergic rhinitis is mediated by an immunoglobulin E (IgE) Type-1 inflammatory disorder of the nasal membrane following exposure to an allergen, characterized by the presence of one or more symptoms that include sneezing, itching, nasal congestion, and rhinorrhea. Mucosal inflammation in allergic rhinitis is characterized by tissue eosinophilia. The present study has been designed to verify the specificity and sensitivity of nasal smears in the diagnosis of allergic rhinitis compared to the gold standard of peripheral blood smears. *Methods*: Our study was conducted on 90 patients with allergic rhinitis and 90 age-sex-matched controls of non-allergic rhinitis. Smears were obtained from nasal secretions and peripheral blood. Smears from both groups were fixed and stained and studied under light microscopy. *Results*: In allergic and non-allergic rhinitis, the sensitivity, specificity, positive predictive value, and negative predictive value of nasal smear tests were 76.66, 87.77, 86.25, and 79%, respectively. The present study documented the premise that a significant difference in nasal smear and peripheral blood smear eosinophilcount exists in patients of allergic rhinitis as compared to the counts of normal health adults, exemplifying the fact that nasal eosinophilia could act as an informative first tool of point of contact for the provisional diagnosis of allergic rhinitis. *Conclusion*: Nasal smear eosinophil cytology is a simple, economical, and semi-invasive procedure that could be used as a diagnostic and prognostic test for patients suffering from allergic rhinitis.

Keywords: Allergic rhinitis, Nasal eosinophilia, Blood eosinophilia

Indian Journal of Physiology and Allied Sciences (2024); DOI: 10.55184/ijpas.v76i02.205 **ISSN:** 0367-8350 (Print)

INTRODUCTION

The term *'Allergy'* originally called *'Allergie'* is a German word coined by two scientists and pediatricians, *Clemens Peter Freiherr von Pirquet (an Austrian) and a Hungarian, Bela Schick, in 1906.* They combined the Greek roots *allos,* "other, different, or strange," and *ergon,* "activity".[1]

Allergic rhinitis (AR) is a global health problem mostly seen by otolaryngologists; the prevalence rate hasbeen reported as 10 to 30% of adults and up to 40% of children.[2] According to National Health Portal (2016), around 20 to 30% of the Indian population suffers from one of the allergic diseases.[3] Allergic rhinitis is mediated by an immunoglobulin E (IgE) type-1 inflammatory disorder of the nasal membrane following exposure to an allergen, characterized by one or more symptoms that include sneezing, itching, nasal congestion, and rhinorrhea. It leads to exaggerated activation of certain cells in the human body that may be triggered by immunoglobulin E, mast cells, basophils, and eosinophils, which play an important element in inflammatory reactions.[4] Mucosal inflammation in allergic rhinitis is characterized by tissue eosinophilia.[5] It can also be associatedwith co-morbid conditions such as asthma, atopic dermatitis, or nasal polyps. It has a significant impact on the quality of life as well as abated productivity in the workplace.[6] Eyermann, in 1927, first documented[7] a strong and conclusive correlation between allergic rhinitis and nasal eosinophil count. Later on, many studies supported the concept,[8-10] while others contradicted it.[11]

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How to cite this article: Chaudhary S, Kumar U, Kumar M, Dube A. A comparative study of eosinophil count in nasal smear and peripheral blood smear in allergic and non-allergic rhinitis patients. *Indian J Physiol Allied Sci* 2024;76(2):31-34.

Conflict of interest: None

Submitted: 14/04/2024 **Accepted:** 20/05/2024 **Published:** 29/06/2024

In geographical areas where the prevalence of allergens exists, allergens play a major role as the etiological factor is higher in allergic respiratory disorders. Confirmation of an allergen as an etiologic agent is cumbersome in a small setup. The diagnosis of allergic rhinitis is confirmed by an array of investigative tools like the skin prick test, ELISA, radio-allegro sorbent assay (RAST), and serum IgE antibody levels that tend to be expensive and available in select high-end healthcare settings.[12] Nasal smear eosinophil count and peripheral blood eosinophil count are simple, economical, and semi-invasive for the diagnosis of AR.[6]

The present study has been designed to verify the specificity and sensitivity of nasal smears in the diagnosis of allergic

rhinitis compared to the gold standard of peripheral blood smears.

MATERIALS AND METHODS

The present study, a comparative prospective research protocol, was conducted in the upgraded Department of Physiology in collaboration with the Allergy and Pulmonary Medicine Clinic at SMS Medical College and Attached Hospitals, Jaipur, after obtaining desired clearance from the Institutional Research Review Board (IRRB) and Ethics Committee of the Institution. Informed written consent was taken from all participants before the start of the study.

Data for the present study were collected from 180 cases (90 cases in each group) of allergic rhinitis patients aged 18 to 55 years of both genders attending the outpatient department of Allergy and Pulmonary Medicine Clinic SMS Hospital, Jaipur. Patients diagnosed with allergic rhinitis and positive skin prick tests were selected. An equal number of the non-allergic rhinitis, age, and sex-matched individuals from hospital staff and patient relatives are considered as controls. Exclusion criteria included an upper respiratory tract infection, recent medical therapy for rhinitis, and the use of systemic or intranasal steroid therapy during the previous month.

There are different opinions regarding the cut-off values of eosinophil counts in nasal smear and blood. As per the recommendation of IAP,[3] a cut-off value of 10 cells per high-power field has been accepted for the current study. Similarly, a blood eosinophil count of > 440 cells/cu.mm. has been accepted for the current study, as per recommendations of Chowdary *et al.*[13]

Nasal Smear Preparation

Smears of nasal secretions were obtained from the middle third of the inferior turbinate of both nostrils using a sterile cotton swab. They were then fixed on a slide with 95% ethyl alcohol and stained with Wright-Giemsa solution. Upon examination with high power, the presence of an average of 10 eosinophils per high-power field was considered positive.

Peripheral Smear Preparation

The absolute eosinophil count was performed as per standard procedure. Peripheral blood smears were studied using Leishman's stain. A count of more than 440 cells per cubic millimeter was considered positive for the absolute eosinophil count.

RESULTS

This study was conducted on 180 patients (90 cases in each group). The study population had 52 males and 38 females, with a mean age of 29.93 with a standard deviation of 9.11, whereas the control group had 46 males and 44 females, with a mean age of 29.22 with a standard deviation of 9.05.

The allergic rhinitis patients had higher nasal smear eosinophils count (19.16 ± 1.2/hpf) than that observed in non-allergic rhinitis cases (3.43 ± 0.75/hpf), a statistically significant difference ($p < 0.05$) between the two groups of the study population. The allergic-rhinitis patients also exhibited high mean blood eosinophils of 460.43/cu.mm., as compared to that observed in non-allergic rhinitis controls with a count of 185.23/cu.mm., a statistically significant difference, $p < 0.05$ (Figure 1).

In the study population of the nasal smear eosinophil count, 68 patients had positive eosinophil count, while only 12 controls demonstrated positive eosinophil counts. As indicated by Figure 1, the negative counts were 23.33 and 87.77% in patients and controls, respectively. On the other hand, 35.55% of patients and only 10% of controls had positive counts in terms of absolute eosinophil counts (Figure 2), amounting to negative results in 58 patients and 81 controls.

The comparative test (of nasal and blood eosinophils counts) in the study population had a sensitivity of 73.68% and specificity of 23.07%, a positive predictive value, and a negative predictive value of 41.07and 54.54%. The difference so observed was statistically significant with $p < 0.05$.

DISCUSSION

Allergic rhinitis is a hypersensitivity reaction mediated by IgE to common allergens like molds, pollen, house mites, animal dander, etc., inducing recruitment of many inflammatory cells and inflammatory mediators in the nasal mucosa inclusive of an increased eosinophils count within nasal smear/brush/biopsy.[6] Moreover, in addition to such high-end

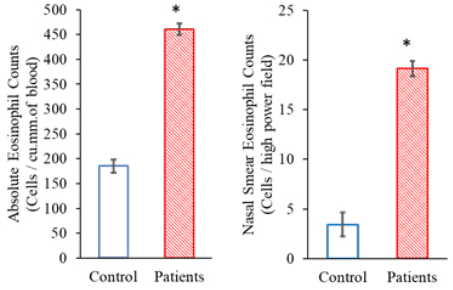

Figure 1: Absolute eosinophil counts and Nasal smear eosinophil counts in control allergic rhinitis patients. Each column represents the mean ± standard error of the mean of 90 observations. * indicates a significant ($p < 0.05$) difference between the mean values of control and patients.

Table 1: Contingency table for the nasal and blood eosinophil counts of the study group

Nasal eosinophil	*Blood eosinophil*			
	>440 cells/ cu.mm	*<440 cells / cu.mm*	*Total*	
>10 cells/high power field	28	40	68	Sensitivity 73.68
<10 cells/high power field	10	12	22	Specificity 23.07
Total	38	52	90	PPV 41,17 NPV 54.54

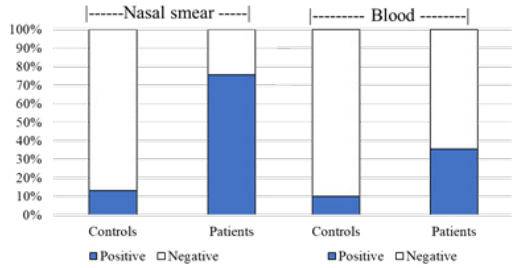

Figure 2: Distribution of positive cases (> 10 Eosinophils/high power field for nasal smear and > 440 eosinophils/cu. mm. of blood) in terms of nasal smear study and absolute eosinophil study

Table 2: Comparison between nasal and blood smear eosinophil counts for their sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy for the patients and control population

	Nasal eosinophil	*Blood eosinophil*
Sensitivity	76.66	35.55
Specificity	87.77	90.00
PPV	86.25	78.04
NPV	79.00	58.27
Accuracy	82.29	32.45

investigative tools for allergic rhinitis, nasal and blood smear eosinophil counts happen to be simple, less invasive, and more economical investigative tools that could be utilized in assessing patients who have been clinically diagnosed as suffering from allergic rhinitis. Subsequently, the present research design was evolved to assess the relationship between nasal and blood smear eosinophil counts.

Using the specified cut-off value, the present study documented that 76.6% of allergic rhinitis patients recruited exhibited significant levels of eosinophils in the nasal mucosal smear. Similar observations were reported by earlier studies. [12,14] However, the nasal mucosal smear cytology of the normal control population of the present study exhibited a mean eosinophil count that is higher than the already reported values by others.[8,15]

In the present study, nasal smear eosinophilia had a specificity of 87.77% and a sensitivity of 76.66%, suggesting nasal smear cytology to be a potentially valuable test for patients with allergic rhinitis, a finding that is similar to earlier observations.[10,11,16] Although there are reports concluding only little value of the nasal smear eosinophil count in the evaluation of allergic rhinitis,[17] the higher positive predictive value of the nasal smear cytology test in the current study when compared with that already reported[18] suggests the importance of the current study.

In the present study, the sensitivity of nasal and blood eosinophil count was 76.66 and 35.55%, respectively, though the specificity indices for nasal and blood smear eosinophilic cytology were 87.77 and 90.00%, respectively. These values were similar to those reported earlier.[6,18] On the other hand, Lans *et al.* reported highly specific, but the sensitivity index for the smear cytology could not be as certain.[19]

In this context and with the incriminating results of the present study, nasal eosinophilia seems to be a highly specific and moderately sensitive test similar to that reported earlier.[16,20] The nasal smear cytological evaluation for eosinophils, with adequate and proper technology, could contribute to the differential diagnosis of various related afflictions that induce a hyperimmune response in the form of exaggerated nasal smear cytological eosinophilia like persistent rhinitis inclusive of allergic rhinosinusitis; non-allergic rhinosinusitis with eosinophilia; and viral infections or bacterial rhinosinusitis.[21]

The present study summarized as the nasal mucosal cytological assessment in patients with allergic rhinitis exhibits a high mean nasal smear eosinophils count as compared to that observed in the non-allergic rhinitis normal control population with a difference that was observed to be statistically significant (with a value of $p < 0.05$). The present study has implicated the potential role of nasal smear cytology in the diagnosis and prognosis of patients with allergic rhinitis.

The present study may be limited by – (a) the unreliable risk factors and frequency of illness as the information about symptoms and medicines may not be proper, (b) inadequate accuracy of the staining procedure, (c) errors may occur in the manual counting of cells, and (d) number of patients used in this study is small. On the other hand, the strength of the current study may be – (a) ease of sample collection for the study, (b) quick processing of the collected samples, and (c) good compliance of the study population.

Allergic rhinitis is associated with bronchial asthma as a comorbidity, so it is important to know and avoid risk factors like seasonal variation, pollen allergy, and animal dander. Early recognition of risk factors and prevention helps in avoiding associated co- morbidity. The nasal smear cytological evaluation for eosinophils could also act as an index for the flip-flop switch regulating the hyper-immune response.

However, further evaluation of nasal smear eosinophils with a larger sample size may be needed to use the reported facts clinically.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.