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Absolute Eosinophil Count as a Prognostic Factor in the Treatment of Allergic Rhinitis – A Descriptive Longitudinal Study in a Tertiary Care Hospital.

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Abstract

Background: Allergic rhinitis is a common inflammatory disorder characterized by sneezing, rhinorrhea, nasal itching, and nasal obstruction, significantly affecting patients' quality of life. AEC (Absolute Eosinophil Count) is a simple and economical investigation that may help assess treatment response. This study evaluated the significance of AEC as a prognostic marker in allergic rhinitis. ***Methods:*** This descriptive longitudinal study was conducted in the Department of Otorhinolaryngology at Mandya Institute of Medical Sciences, Mandya, from March 2021 to February 2022. A total of 350 patients diagnosed with allergic rhinitis were included. Detailed history-taking and clinical examination were performed, and symptoms were assessed using the VAS (Visual Analogue Scale). Patients were classified into IAR (Intermittent Allergic Rhinitis) and PAR (Persistent Allergic Rhinitis) according to ARIA guidelines. Baseline AEC values and symptom scores were recorded, followed by standardized treatment for 28 days. Post-treatment symptom scores and AEC values were compared with baseline measurements using appropriate statistical tests. ***Results:*** Allergic rhinitis accounted for 19.4% of patients attending the ENT outpatient department, with a slight male preponderance. Among the 350 participants, 201 (57.4%) had IAR and 149 (42.6%) had PAR. Rhinorrhea was the predominant symptom in IAR, whereas itching and nasal obstruction were prominent in PAR. Hypertrophied inferior turbinate was the most common clinical sign in both groups. Significant improvement was observed in rhinorrhea, itching, sneezing, and nasal obstruction following four weeks of treatment ($p<0.005$). Mean AEC decreased from 351.91 to 225.68 in IAR and from 690.05 to 417.41 in PAR, with statistically significant reductions in both groups ($p<0.001$). ***Conclusion:*** AEC is a simple, accessible, and economical prognostic marker for monitoring treatment response in allergic rhinitis. Although it should not be used as a standalone diagnostic investigation, it can complement clinical assessment and symptom evaluation.

Keywords: Allergic Rhinitis, Absolute Eosinophil Count, Intermittent Allergic Rhinitis, Persistent Allergic Rhinitis, Visual Analogue Scale, Prognosis.

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INTRODUCTION

Rhinitis is clinically defined by the presence of two or more nasal symptoms, including rhinorrhea, nasal obstruction, nasal itching, and sneezing. Allergic rhinitis (AR) occurs when these symptoms result from immunoglobulin E (IgE)-mediated inflammation following exposure to specific allergens.[1] Despite its high prevalence, allergic rhinitis is a heterogeneous disorder that frequently remains underdiagnosed.

Approximately 50% of all cases of rhinitis are attributed to allergic causes. In allergic rhinitis, symptoms develop due to an IgE-mediated immune response to specific allergens, such as pollens, molds, animal dander, and house dust mites. This immune response triggers the release of inflammatory mediators and the activation and recruitment of inflammatory cells into the nasal mucosa, resulting in characteristic clinical manifestations.[2]

According to the ARIA (Allergic Rhinitis and its Impact on Asthma) guidelines, allergic rhinitis is classified into intermittent and persistent types. These categories are further subdivided into mild and moderate-to-severe forms based on symptom severity and their impact on the patient's quality of life, including daily activities, social interactions, school performance, and work productivity.[3]

The pathophysiology of allergic rhinitis is complex and involves both genetic predisposition and environmental factors. Common causative allergens include pollens, molds, dust mites, and animal dander. The allergic response is characterized by the infiltration and activation of inflammatory cells, particularly plasma cells, mast cells, and eosinophils, within the nasal mucosa. The immune response occurs in two distinct phases: the early-phase and late-phase responses. The early-phase response develops within minutes of allergen exposure and is characterized predominantly by sneezing, nasal itching, and watery rhinorrhea. The late-phase response typically occurs 4–8 hours after exposure and is associated with nasal congestion, fatigue, malaise, irritability, and potential neurocognitive impairment. Recognition of these characteristic signs and symptoms is essential for the clinical diagnosis of allergic rhinitis.[4,5] Allergic rhinitis is an increasingly prevalent global health concern, affecting approximately 10–40% of the world's population.[6]

AIMS AND OBJECTIVES

The present study aims to determine the significance of AEC (Absolute Eosinophil Count) as a prognostic marker in the treatment of allergic rhinitis. The objectives are to assess the role of absolute eosinophil count in predicting treatment outcomes and evaluating the prognosis of patients with allergic rhinitis, to determine the proportion of patients presenting with allergic rhinitis in the Department of Otorhinolaryngology (ENT), and to describe the clinical symptoms and signs observed in patients diagnosed with allergic rhinitis.

MATERIALS AND METHODS

Study Design

This longitudinal observational study was conducted in the Department of Otorhinolaryngology (ENT) at the teaching hospital of Mandya Institute of Medical Sciences, Mandya. The study was carried out over a period of one year, from March 2021 to February 2022.

Inclusion and Exclusion Criteria

The study included patients aged 18 years and above who presented to the Department of Otorhinolaryngology at Mandya Institute of Medical Sciences (MIMS), Mandya, with symptoms suggestive of allergic rhinitis and who provided informed consent to participate in the study. Patients presenting with acute rhinosinusitis, rhinitis medicamentosa, or vasomotor rhinitis were excluded from the study.

Sample Size Calculation

The prevalence of blood eosinophilia in allergic rhinitis was 54%.[7]
TN= Z2 ×p × (1-p) / d2 Z= 1.96
p= 0.54
1-p= (1-0.54) =0.46
d = 10 x 0.54 /100 =0.054
Here,
Z2 = Standard normal variate (1.96)
p = Prevalence of blood eosinophilia in allergic rhinitis. d = Relative error or precision (10%).
N = 1.96 x 1.96 x .54 x .46 / (.0542) = 327
Hence sample size is 350.

Data Collection Procedure

Informed written consent was obtained from all study participants after explaining the purpose and objectives of the study in a language familiar to them. A detailed clinical history was obtained from patients presenting with symptoms of allergic rhinitis, including nasal obstruction, nasal discharge, recurrent sneezing, and itching of the nose and eyes. A thorough clinical examination was performed, and the findings were recorded in a specially designed clinical proforma. Investigations, including the percentage of eosinophils in the differential leucocyte count, CRP (C-Reactive Protein), and AEC, were performed for all participants. Patients with elevated CRP levels and leucocyte counts were excluded from the study. The severity of clinical symptoms, including nasal discharge, nasal obstruction, sneezing, and itching, was assessed using a VAS ranging from 1 to 10, with scores of 5 or below indicating mild symptoms and scores of 6 or above indicating severe symptoms. Patients were classified into intermittent and persistent allergic rhinitis according to the ARIA classification. Symptoms occurring for fewer than four days per week or for fewer than four consecutive weeks per year were classified as intermittent, whereas symptoms occurring for more than four days per week and for more than four consecutive weeks per year were classified as persistent allergic rhinitis. Based on symptom severity and impact, patients were further categorized as having mild or moderate-to-severe disease. All participants received standardized treatment according to ARIA guidelines and were reassessed after four weeks. Symptomatic improvement was evaluated using the VAS, and pre-treatment and post-treatment AEC values were compared. Eosinophil counts were categorized as normal (AEC below 500 cells/µL), mild (600–1,500 cells/µL), moderate (1,500–5,000 cells/µL), and severe (above 5,000

cells/µL), as per the classification adopted in the study. Appropriate statistical tests were applied to evaluate the association between AEC levels, treatment response, and the prognostic significance of AEC in patients with allergic rhinitis.

Statistical Analysis

All collected data were entered into Microsoft Excel and statistically analyzed using SPSS software. Descriptive statistics, including proportions and percentages for categorical variables and mean and standard deviation for quantitative variables, were used. Inferential statistics included the paired t-test to compare mean eosinophil counts before and after the intervention and the chi-square test to assess the association between AEC and allergic rhinitis. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Gender Distribution of Allergic Rhinitis Patients by Type of AR

Type of AR	Male n (%)	Female n (%)	Total
Intermittent (57.4%)	106 (52.7)	95 (47.3)	201
Persistent (42.6%)	81 (54.3)	68 (45.7)	149
Total	**187**	**163**	**350**

Table 1 illustrates the gender distribution of the 350 study subjects across the two types of allergic rhinitis. These subjects were enrolled consecutively from the 7571 patients (19.4%) who presented with AR symptoms among the 39232 patients attending the ENT OPD between March 2021 and February 2022. Of the 350 patients, 187 were males and 163 were females. Intermittent AR accounted for 201 patients (57.4%) and persistent AR for 149 patients (42.6%). Males formed 52.7% of the intermittent group and 54.3% of the persistent group, while females formed 47.3% and 45.7% respectively, showing a slight male preponderance in both types.

Table 2: Age and Gender Distribution of the Study Subjects

Age Group (years)	Male n (%)	Female n (%)	Total n (%)
18–30	70 (20)	67 (19.14)	137 (39.14)
31–50	70 (20)	83 (23.71)	153 (43.71)
51–70	31 (8.8)	24 (6.8)	55 (15.7)
>70	3 (0.85)	2 (0.57)	5 (1.42)

Table 2 shows the age-wise and gender-wise distribution of the 350 patients. The largest share of subjects belonged to the 31–50-year-old group (43.7%), followed by the 18–30-year-old group (39.1%). The 51–70-year-old group accounted for 15.7% and only 1.4% of patients were above 70 years of age. Allergic rhinitis was therefore predominantly seen in young and middle-aged adults, with a mean age of 37.5 years.

Table 3: Classification of Allergic Rhinitis by Type and Severity

Classification	Intermittent AR (n = 201)	Persistent AR (n = 149)
Mild	124 (61.6%)	32 (21.4%)
Moderate–severe	77 (38.4%)	117 (78.6%)
– Troublesome symptoms	45 (58.4%)	64 (54.7%)
– Disturbed sleep	26 (33.7%)	13 (11.11%)
– Both	6 (7.7%)	40 (34.18%)

Table 3 depicts the classification of intermittent and persistent AR based on the severity of troublesome symptoms. Among intermittent AR cases, 61.6% had mild disease and 38.4% had moderate-to-severe disease. In contrast, among persistent AR cases only 21.4% were mild, whereas 78.6% were moderate-to-severe. Within the moderate–severe group (percentages shown are of that group), troublesome symptoms alone were the commonest feature in both intermittent (58.4%) and persistent AR (54.7%). Disturbed sleep with troublesome symptoms together was far more frequent in persistent AR (34.18%) than in intermittent AR (7.7%), indicating a greater burden of disease in persistent AR.

Table 4: Severe Symptoms and Clinical Signs in IAR and PAR

Feature		IAR n (%)	PAR n (%)
Severe symptoms (VAS score above 5)	Rhinorrhoea	104 (51.7)	81 (54.3)
	Itching	46 (22.8)	104 (69.7)
	Nasal obstruction	75 (37.3)	132 (88.5)
	Sneezing	27 (13.4)	89 (59.7)
Clinical signs	Pale mucosa	113 (56.2)	81 (54.36)
	Turbinate hypertrophy	181 (90.04)	127 (85.23)
	Adenoid hypertrophy	12 (5.97)	16 (10.73)
	TM retraction	27 (13.43)	55 (36.91)

Table 4 observes the clinical presentation of the patients in terms of severe symptoms and examination findings. Almost all patients (98.4%) had all four clinical symptoms of AR with varying degrees of severity. In intermittent AR, rhinorrhoea was the most severe symptom (51.7%), followed by nasal obstruction (37.3%) and itching (22.8%), with sneezing the least common (13.4%). In persistent AR, nasal obstruction (88.5%) and itching (69.7%) were the most frequent severe symptoms, followed by sneezing (59.7%) and rhinorrhoea (54.3%). With regard to signs, turbinate hypertrophy was the commonest finding in both IAR (90.04%) and PAR (85.23%), followed by pale mucosa (56.2% and 54.36%). Tympanic membrane retraction was considerably more common in PAR (36.91%) than in IAR (13.43%), and adenoid hypertrophy was the least common sign in both groups (5.97% in IAR and 10.73% in PAR).

Table 5: Distribution of AEC Before and After Treatment by Gender

AEC	1st visit – Male	1st visit – Female	2nd visit – Male	2nd visit – Female
<500	106	104	154	146
501–1500	65	70	19	30
>1500	3	2	1	0

Table 5 presents the distribution of AEC categories among the 350 AR patients at the first visit and after 4 weeks of treatment, separately for males and females. The number of patients with AEC below 500 increased after treatment (males from 106 to 154 and females from 104 to 146), whereas the number in the 501–1500 category fell (males from 65 to 19 and females from 70 to 30). Patients with AEC above 1500 reduced from 3 to 1 among males and from 2 to 0 among females. The whisker plots showed the same trend: the median AEC was 420 at the first visit (minimum 40, maximum 3709, first quartile 247.7, third quartile 660) and fell to 257 at follow-up (minimum 70, maximum 1800, first quartile 168, third quartile 400), with more outliers at the first visit.

Table 6: Comparison of Mean AEC Before and After Treatment in IAR and PAR

Group	N	Mean ± SD (1st visit)	Mean ± SD (2nd visit)	Paired t value	P value
AEC in IAR	201	351.91 ± 194.89	225.68 ± 119.114	18.27	<0.001
AEC in PAR	149	690.05 ± 422.863	417.41 ± 227.366	15.249	<0.001

Table 6 compares the mean AEC at the first visit and after 4 weeks of treatment in the two types of AR. In the 201 intermittent AR patients, the mean AEC decreased from 351.91 (SD 194.89) to 225.68 (SD 119.114). In the 149 persistent AR patients, it decreased from 690.05 (SD 422.863) to 417.41 (SD 227.366). The paired t-test showed that the reduction was statistically significant in both groups ($p < 0.001$). The mean AEC at baseline was also higher in persistent AR than in intermittent AR.

Table 7: Comparison of VAS Scores for Nasal Symptoms Before and After Treatment in IAR and PAR

Symptom	Group	N	Mean ± SD (1st visit)	Mean ± SD (2nd visit)	Paired t value	P value
Runny nose	IAR	201	4.51 ± 1.323	2.54 ± 0.954	24.708	<0.001
Runny nose	PAR	149	4.91 ± 1.641	2.44 ± 1.074	23.145	<0.001
Nasal obstruction	IAR	201	3.96 ± 1.452	1.65 ± 0.663	22.873	<0.001
Nasal obstruction	PAR	149	5.41 ± 1.053	2.17 ± 0.623	39.384	<0.001
Itching	IAR	201	3.88 ± 1.070	1.78 ± 0.652	24.915	<0.001
Itching	PAR	149	5.25 ± 1.433	1.82 ± 0.717	27.125	<0.001
Sneezing	IAR	201	2.81 ± 1.521	1.18 ± 0.686	19.669	<0.001
Sneezing	PAR	149	4.79 ± 1.407	1.77 ± 0.727	33.356	<0.001

Table 7 observes the change in VAS scores for the four cardinal symptoms of allergic rhinitis between the first visit and 4 weeks after standardised ARIA-based treatment. All four symptoms (runny nose, nasal obstruction, itching and sneezing) showed a fall in mean score in both intermittent and persistent AR, and every change was statistically significant on the paired t-test ($p < 0.001$). The baseline scores were generally higher in persistent AR, and the largest improvement was seen for nasal obstruction in PAR (5.41 to 2.17; $t = 39.384$). Follow-up scores in all groups were below 2.6, showing good symptomatic response to treatment alongside the reduction in AEC.

DISCUSSION

Allergic rhinitis is an IgE-mediated inflammatory disease of the nasal mucosa characterized by nasal congestion, rhinorrhoea, itching and sneezing. According to ARIA guidelines, AR is classified as intermittent or persistent and as mild or moderate to severe. Treatment includes allergen avoidance, pharmacotherapy, immunotherapy and surgery. Antihistamines are commonly used for mild to moderate disease, with ≥50% of patients receiving antihistamines and approximately 30% receiving INCS (Intranasal Corticosteroids).[8,9] AEC is an economical, simple and noninvasive investigation that may help assess AR severity.[7]

Allergic Rhinitis and Absolute Eosinophil Count

In the present study, 60% of patients had normal AEC, 38.5% had mild eosinophilia (500–1500) and 1.5% had moderate eosinophilia. Akanksha Agarwal et al. reported elevated AEC and serum IgE in 39 (37.1%) of 105 patients, with a positive but statistically insignificant association ($p > 0.05$), comparable to the 40% of patients with raised AEC in our study.[10] Mirza Khizar Hameed et al. found elevated serum IgE in 152 (76%) patients and total eosinophil counts in 104 (52%); serum IgE was reported as significant ($p \leq 0.50$), whereas total eosinophil count was not ($p \geq 0.50$).[11] Patel AK (2014) et al. observed no correlation between blood AEC and clinical severity among 70 patients, with 94.29% showing no eosinophilia.[12] These findings suggest that AEC alone may not be a sensitive diagnostic marker for AR.

In our study, AEC improved significantly after treatment in both intermittent and persistent AR groups. Paired t-test analysis demonstrated a significant difference between the initial and follow-up assessments ($p = 0.001$). Nandish Chennakeshavaraju et al. reported a significant reduction in blood and nasal smear eosinophil counts ($p = 0.001$) after 15 days of treatment with fluticasone furoate or azelastine hydrochloride in 150 patients.[13] Jayagar Prabhakaran et al. concluded that nasal smear eosinophilia was more reliable than AEC for diagnosing AR.[14] Anshu Makkar et al. also reported a significant reduction in AEC after 3 months of follow-up.[15] Neelima Vijayan found that elevated AEC and serum IgE were associated with coexisting AR and bronchial asthma.[16] Dr. Manish Kumar Sachan et al., emphasized the cost-effectiveness and accessibility of AEC testing in rhinitis.[17]

Proportion of Allergic Rhinitis

The proportion of patients with AR attending the otorhinolaryngology outpatient department in our study was 19.4%. The ECRHS (European Community Respiratory Health Survey) reported an overall prevalence of 21% in 2001.[18] A population-based survey in western Europe found that 19% of adults reported awareness of AR, while 13% had received a physician-based diagnosis.[19] Keerthivardhan D et al. reported AR prevalence of 57.5% among asthmatics and 17.5% among nonasthmatics.[20] These findings indicate that AR affects a substantial proportion of the population, highlighting the importance of awareness and early diagnosis.

Age Distribution

In our study, participants were aged 18–60 years, with a mean age of 37.5 years. The largest proportion (43.7%) belonged to the 31–50-year age group, followed by 39.1% aged 18–30 years, 15.7% aged 51–70 years and 1.4% aged above 70 years. Navarro A. et al. reported a mean age of 30 ± 15 years among patients with AR, while Choudhari S Y (2017) et al. reported an age range of 17–75 years.[9,21] Differences in occupational and environmental allergen exposure may contribute to variations in age and sex distribution.

Gender Distribution

Our study showed a slight male predominance, with males accounting for 52.7% of intermittent AR cases and 54.3% of persistent AR cases. Varshney and Varshney (2014) similarly reported a higher occurrence among males.[22] In contrast, Abdulmohsin A. Almehizia et al. reported female predominance, with 59.4% females and 40.6% males.[23] Naveen Kumar et al. found that allergic disorders were more common among males (62%).[7] Occupational and environmental exposures may partly explain these differences.

Classification of Allergic Rhinitis

According to ARIA guidelines, 201 patients (57.4%) in our study had intermittent AR, while 149 (42.6%) had persistent AR. Among intermittent cases, 61.6% had mild symptoms and 38.4% had moderate to severe symptoms. Among persistent cases, 21.4% had mild symptoms and 78.6% had moderate to severe symptoms. D Muddaiah et al. reported mild, moderate and severe AR in 66.3%, 6.9% and 26.9% of 160 patients, respectively.[23] A Praglatha Kumar et al. found intermittent and persistent AR in 56% and 44% of 130 children, respectively, comparable to our findings.[24] Shyna K P et al. reported intermittent mild and moderate/severe AR in 43% and 21%, respectively, and persistent mild and moderate/severe AR in 20% and 16%, respectively, among children aged 6–15 years.[25]

Signs and Symptoms of Allergic Rhinitis

Based on VAS scores, rhinorrhoea was the most severe symptom in intermittent AR, followed by itching and sneezing, while nasal obstruction was the least severe. In persistent AR, sneezing and rhinorrhoea were the most severe symptoms, followed by nasal obstruction. J Prabhakaran et al. reported rhinorrhoea (97%), sneezing (82%) and nasal obstruction (41%) as common presenting symptoms.[26]

Impact of Treatment on Subjective Outcomes

In our study, VAS scores were assessed at diagnosis and 28 days after treatment initiation. Both intermittent and persistent AR groups showed significant improvement in all four nasal symptoms after 4 weeks of standardized treatment. In intermittent AR, the reduction in rhinorrhoea scores was statistically significant ($p = 0.001$), with similar improvements in

nasal obstruction, itching and sneezing. Persistent AR cases also demonstrated significant improvement in all four symptoms after 28 days.

Angshuman Dutta et al. reported a strong positive correlation between the NOSE scale and AEC among 140 patients with AR ($r_s = 0.905$, $p < 0.001$).[27] Soumya Annu Achankunju et al., in a study of 60 patients with mild persistent or moderate to severe intermittent AR, found significant reductions in TNSS (Total Nasal Symptom Scores) and AEC following treatment with montelukast–levocetirizine or montelukast–fexofenadine; both combinations were equally tolerable.[28] Our findings demonstrate significant symptomatic improvement and a reduction in AEC following treatment. However, AEC should be interpreted alongside clinical symptoms and other diagnostic findings rather than used as an independent diagnostic marker.

Limitations

More specific and sensitive investigations, such as serum IgE estimation and nasal smear eosinophil count, were not performed. As the study was based solely on clinical findings and symptom scores, it could not identify the specific causative aeroallergens or assess the role of allergen avoidance.

CONCLUSION

Allergic rhinitis is a chronic clinical condition that imposes a considerable burden on individuals and society. It often remains undiagnosed, leading to inadequate symptom control. AEC is an economical screening tool for patients with persistent nasal symptoms. Although AEC is not a definitive diagnostic test, the present study suggests that it may help assess improvement in the signs and symptoms of allergic rhinitis following treatment in both IAR and PAR, making it a simple and useful prognostic marker. The study also demonstrated a high proportion of allergic rhinitis among ENT outpatients, with young individuals being more frequently affected and a slight male predominance. As the burden of allergic rhinitis is often underestimated, accurate diagnosis and appropriate treatment planning require careful correlation of clinical history, examination findings, and relevant diagnostic investigations.

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