

Correlation of Induced Sputum Eosinophil and Absolute Eosinophil Count in Assessing The Severity of Bronchial Asthma

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Abstract:

Background & Objectives:

Bronchial asthma is a heterogeneous inflammatory airway disease in which eosinophils play a key pathogenic role. While peripheral blood absolute eosinophil count (AEC) is commonly used as a biomarker, it may not accurately reflect airway inflammation. Induced sputum eosinophil count provides a direct assessment of airway inflammation. This study aimed to evaluate the correlation between induced sputum eosinophils, serum AEC, and their ratio with asthma severity and to assess their utility in predicting treatment response.

Methods:

This prospective study included 47 adult patients with bronchial asthma attending a tertiary care hospital. Baseline evaluation included clinical assessment, Asthma Control Test (ACT), spirometry, induced sputum eosinophil percentage, and serum AEC. Asthma severity was classified according to GINA guidelines.¹ Patients received standard inhaled corticosteroid-based therapy and were followed up at 1 and 3 months. Changes in clinical, functional, and inflammatory parameters were analyzed using appropriate statistical tests.

Results:

Sputum eosinophil percentage, serum AEC, and sputum eosinophil/AEC ratio increased significantly with asthma severity ($p < 0.001$), while FEV₁% predicted decreased. Both sputum eosinophils and serum AEC showed strong negative correlations with FEV₁ and ACT scores. Following treatment, there was significant improvement in ACT scores and FEV₁, along with a marked reduction in sputum eosinophils and serum AEC ($p < 0.001$). Higher baseline sputum eosinophil levels predicted better lung function improvement.

Conclusion:

Induced sputum eosinophil count correlates strongly with asthma severity and treatment response and appears to be a more reliable marker of airway inflammation than peripheral blood eosinophil count. Incorporating sputum eosinophil assessment may enhance individualized asthma management.

INTRODUCTION:

Bronchial asthma is a chronic heterogeneous inflammatory disease of the airways characterized by variable airflow limitation and airway hyper-responsiveness. It affects more than 300 million people worldwide and remains a major cause of morbidity¹. The disease is driven by airway inflammation in which eosinophils play a pivotal pathogenic role. Assessment of airway inflammation is crucial for evaluating disease severity and therapeutic response. Blood Absolute Eosinophil Count (AEC) is frequently used as a biomarker due to easy availability. However, peripheral blood eosinophils may not reflect true airway inflammatory activity. Induced sputum eosinophil count directly measures airway eosinophilic inflammation. There is limited Indian data correlating sputum eosinophils with asthma severity and treatment response.¹

AIM & OBJECTIVES:

Aim:

To study correlation between induced sputum eosinophils, serum AEC and their ratio with asthma severity and treatment response.

Objectives:

- To correlate sputum eosinophil %, serum AEC and sputum eosinophil/AEC ratio with asthma severity.
- To assess relationship of these biomarkers with lung function (FEV₁) and asthma control (ACT).
- To evaluate their role in predicting response to inhaled corticosteroid therapy.

MATERIALS & METHODS:

- **Study Design:** Prospective observational study
- **Study Period:** 1st March 2024 – 1st December 2025
- **Study Setting:** Department of Respiratory Medicine, Rama Medical College & Hospital

Sample Size Calculation:

Sample size calculated using Cochran's Formula for cross-sectional studies:

$$n = (Z^2 \times p \times (1 - p)) / d^2$$

Where:

n = required sample size

Z = Z value (e.g., 1.96 for 95% confidence level)

p = estimated prevalence or proportion (3%)

d = margin of error (precision)

Calculated Sample Size: n = 47 patients

Inclusion Criteria

- Age group: 18–60 years
- Confirmed diagnosis of bronchial asthma as per GINA guidelines
- Normal chest X-ray

Exclusion Criteria

- Uncontrolled diabetes or autoimmune disorders
- Spirometry suggestive of COPD
- Inability to perform spirometry
- Recent myocardial infarction, congestive heart failure, chronic kidney disease
- Patients on chronic corticosteroid therapy
- Bronchiectasis or other obstructive lung diseases
- History of smoking

- Pregnancy

Methods:

- Baseline assessment included:
 - Clinical evaluation
 - Spirometry (FEV₁ % predicted)
 - Induced sputum eosinophil %
 - Serum Absolute Eosinophil Count
- Patients treated with inhaled corticosteroid-based therapy.
- Follow-up at 1 and 3 months.

Statistical Analysis: SPSS software was used to analyze the data. Data expressed as Mean ± SD or percentages. One-way ANOVA used for comparison between severity groups. Pearson correlation for association was performed. $p < 0.05$ considered statistically significant

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (N=47)

Characteristic	Value
Age (years), Mean \pm SD	38.4 \pm 11.7
Gender, n (%)	
Male	24 (51.1%)
Female	23 (48.9%)
BMI (kg/m ²), Mean \pm SD	24.1 \pm 3.5
Smoking History, n (%)	0 (0%) *
Asthma Duration (years), Mean \pm SD	5.8 \pm 4.2
Asthma Control Test (ACT) Score, Mean \pm SD	15.1 \pm 3.4
FEV ₁ % Predicted, Mean \pm SD	72.3 \pm 16.5

Table 2: Baseline Inflammatory Biomarkers and Lung Function Stratified by Asthma Severity

Parameter	Mild (n=12)	Moderate (n=22)	Severe (n=13)
Sputum Eosinophil % (Mean \pm SD)	2.1 \pm 0.9	4.8 \pm 1.5	8.9 \pm 3.1
Serum AEC (cells/ μ L) (Mean \pm SD)	285.4 \pm 98.7	452.6 \pm 121.3	685.2 \pm 195.4
Sputum Eosinophil / Serum AEC Ratio (Mean \pm SD)	0.007 \pm 0.002	0.011 \pm 0.003	0.013 \pm 0.004
FEV ₁ % Predicted (Mean \pm SD)	88.5 \pm 5.2	73.2 \pm 6.8	55.1 \pm 8.9

Table 3: Correlation of Inflammatory Biomarkers with Clinical and Functional Parameters at Baseline (N=47)

Parameter	Sputum Eosinophil %		Serum AEC		Sputum Ratio
	R	p-value	r	p-value	
FEV₁ % Predicted	-0.724	<0.001	-0.681	<0.001	-0.598
Asthma Control Test (ACT) Score	-0.653	<0.001	-0.592	<0.001	-0.521

Table 4: Treatment Response Based on Sputum Eosinophil Status at Baseline

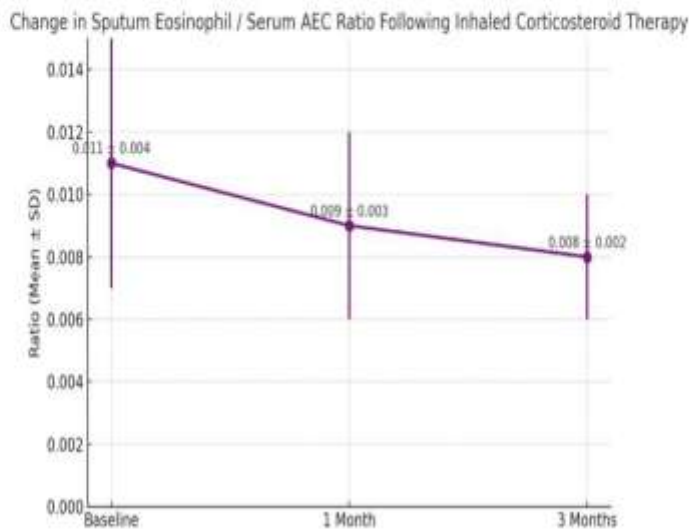
Parameter	Sputum Eosinophil <3% (n=12)	Sputum Eosinophil ≥3% (n=35)	p-value

Improvement in FEV₁ % (Mean ± SD)	8.1 ± 4.5	16.9 ± 7.2	0.001
Achieved Asthma Control (ACT≥20) at 3 months, n (%)	8 (66.7%)	32 (91.4%)	0.045

Time Point Ratio (Mean \pm SD) p-value (vs. Baseline)

Baseline	0.011 \pm 0.004	-
1 Month	0.009 \pm 0.003	0.003
3 Months	0.008 \pm 0.002	<0.001

p-value from Repeated Measures ANOVA

**DISCUSSION:**

- Our study demonstrated a stepwise increase in sputum eosinophil %, serum AEC and sputum eosinophil/AEC ratio with increasing asthma severity ($p < 0.001$). There was a significant decline in FEV₁% predicted from mild to severe asthma, confirming progressive airway inflammation and obstruction. Sputum eosinophil % showed the strongest negative correlation with FEV₁ ($r = -0.724$) and ACT score ($r = -0.653$), suggesting that airway eosinophilia closely reflects clinical severity. These findings are consistent with earlier observations that sputum eosinophilia is a robust marker of airway inflammation and disease activity. Patients with baseline sputum eosinophils $\geq 3\%$ showed significantly greater improvement in FEV₁ and achieved better asthma control at 3 months. This supports the role of sputum eosinophils as a predictor of corticosteroid responsiveness, in line with **Green *et al.*²** who demonstrated reduced exacerbations with sputum-guided therapy. **Pavord *et al.*³** and **Kumar *et al.*⁴** also reported strong associations between sputum eosinophilia and asthma severity, reinforcing the relevance of our findings. Our results emphasize that sputum eosinophil estimation may outperform peripheral blood AEC in identifying eosinophilic phenotype asthma. Our results are further supported by the work done by **Princia Banu Mangattu Parambil *et al.*⁵**

CONCLUSION:

Induced sputum eosinophil count shows a strong correlation with asthma severity and a superior association with lung function and asthma control compared to blood eosinophil count. Higher baseline sputum eosinophils predict a better treatment response to inhaled corticosteroids. Incorporation of sputum eosinophil assessment into routine practice can improve individualized management of bronchial asthma and optimize therapeutic outcomes.

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