Research Article

Eosinophil-Guided Therapy In Chronic Obstructive Pulmonary Disease: Evaluating Blood Eosinophils As Predictors Of Inhaled-Corticosteroids Response

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Abstract

Background-Aim:
Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide and is characterized by persistent airflow limitation and recurrent exacerbations. Although inhaled corticosteroids (ICS) are recommended for patients with frequent exacerbations, the response to therapy varies. Blood eosinophil count has emerged as a potential biomarker for identifying patients who may benefit from ICS-containing regimens. This study evaluated the role of baseline blood eosinophil count as a predictor of response to ICS therapy in COPD.

Materials–Methods:
This prospective observational study was conducted at the Department of Pulmonary Medicine, Sree Balaji Medical College & Hospital, Chennai, India, from August 2024 to March 2026. A total of 156 patients with spirometry-confirmed COPD receiving ICS-containing therapy were included. Patients were categorized into three groups based on baseline blood eosinophil count: <100, 100–300, and >300 cells/µL. Clinical evaluation included CAT score, mMRC dyspnea scale, spirometry, and exacerbation history. Patients were followed for 6 months to assess changes in lung function, symptoms, and exacerbation frequency. Data were analyzed using SPSS version 26.0 with $p < 0.05$ considered statistically significant.

Results:
The mean age of participants was 62.1 ± 8.9 years, with 74.4% males. Patients with eosinophil counts >300 cells/µL showed significantly greater improvement in FEV_1 compared with the other groups ($p < 0.01$). Greater reductions in CAT scores and lower exacerbation rates were also observed in the high eosinophil group ($p < 0.05$). Baseline eosinophil count >300 cells/µL was identified as an independent predictor of improved response to ICS therapy.

Conclusion:
Baseline blood eosinophil count is a useful biomarker for predicting response to ICS therapy in COPD. Higher eosinophil levels are associated with improved lung function, better symptom control, and reduced exacerbations, supporting eosinophil-guided COPD management.

KEYWORDS: Chronic obstructive pulmonary disease (COPD); Blood eosinophil count; Inhaled corticosteroids; Eosinophil-guided therapy; COPD exacerbations; Biomarkers.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide and is characterized by persistent airflow limitation, chronic airway inflammation, and recurrent exacerbations that accelerate lung function decline and impair quality of life (1). Inhaled corticosteroids (ICS), in combination with long-acting bronchodilators, are recommended for patients with frequent exacerbations despite optimal bronchodilator therapy (1). However, the clinical response to ICS in COPD is heterogeneous. While some patients experience substantial reductions in exacerbation frequency, others derive limited benefit and remain exposed to potential adverse effects, including pneumonia and systemic corticosteroid-related complications (2,3). This variability underscores the need for reliable biomarkers to guide individualized treatment strategies.

Blood eosinophil count has emerged as a readily accessible biomarker reflecting type 2 airway inflammation in COPD and is increasingly incorporated into therapeutic decision-making (1,4). Recent analyses and real-world studies suggest that higher blood eosinophil levels are associated with greater reductions in exacerbation risk and improved outcomes with ICS-containing regimens, particularly at thresholds ≥300 cells/µL (4–6). Furthermore, contemporary evidence highlights the prognostic and predictive value of eosinophils in identifying patients most likely to benefit from ICS while minimizing unnecessary exposure (5,7). Nevertheless, questions remain regarding optimal cut-off values, longitudinal stability of eosinophil counts, and their applicability across diverse clinical populations (7,8).

Given these considerations, real-world observational data are essential to validate the predictive role of blood eosinophil count in routine clinical practice. The present observational study aims to evaluate whether baseline blood eosinophil count predicts clinical response to inhaled corticosteroids in patients with COPD, with specific assessment of exacerbation frequency, lung function parameters, and symptom burden.

2. Materials And Methods

2.1 Study Design and Setting

This prospective observational study was conducted in the Department of Pulmonary Medicine at Sree Balaji Medical College & Hospital, Chromepet, Tamil Nadu, India, over a period of 18 months from August 2024 to March 2026. The study aimed to evaluate the role of baseline blood eosinophil count as a predictor of response to inhaled corticosteroid (ICS) therapy in patients with chronic obstructive pulmonary disease (COPD).

2.2 Study Population

Patients (N=156) diagnosed with COPD attending the outpatient department or admitted to the pulmonary medicine ward were screened for eligibility. Diagnosis of COPD was confirmed by post-bronchodilator spirometry showing $FEV_1/FVC < 0.70$, in accordance with standard diagnostic criteria.

2.3 Inclusion Criteria

- Patients with spirometry-confirmed COPD (post-bronchodilator $FEV_1/FVC < 0.70$).
- Patients receiving ICS-containing inhaler therapy (ICS/LABA or single inhaler triple therapy).
- Clinically stable COPD patients attending outpatient or inpatient services.
- Patients who provided written informed consent to participate in the study.

2.4 Exclusion Criteria

- Patients with bronchial asthma or asthma–COPD overlap syndrome.
- Patients with active pulmonary tuberculosis.
- Patients with other chronic lung diseases such as interstitial lung disease or bronchiectasis.
- Patients who had received systemic corticosteroids within the previous 4 weeks.
- Patients with parasitic infections, hematological disorders, or other conditions affecting eosinophil counts.
- Patients with malignancy or severe systemic illness that could influence study outcomes.

2.5 Baseline Assessment

At enrollment, detailed clinical information including age, gender, smoking history, duration of COPD, exacerbation history, and comorbidities was recorded. Symptom severity was assessed using the Modified Medical Research Council (mMRC) dyspnea scale and the COPD Assessment Test (CAT).

2.6 Blood Eosinophil Measurement

Peripheral venous blood samples were collected at baseline for measurement of absolute blood eosinophil count using an automated hematology analyzer. Based on eosinophil counts, patients were categorized into three groups:

- **Low eosinophil group:** <100 cells/µL
- **Intermediate eosinophil group:** 100–300 cells/µL
- **High eosinophil group:** >300 cells/µL

2.7 Spirometry

Pulmonary function testing was performed using standardized spirometry according to ATS/ERS guidelines. Parameters recorded included FEV_1, FVC, and FEV_1/FVC ratio after bronchodilator administration.

2.8 Treatment and Follow-up

All patients received ICS-containing therapy (ICS/LABA or triple therapy) along with standard COPD treatment as per guideline

recommendations. Patients were followed up for 6 months, and clinical response to therapy was monitored.

2.9 Outcome Measures

The primary outcomes included change in CAT score, improvement in FEV_1, and frequency of COPD exacerbations during the follow-up period. An exacerbation was defined as acute worsening of respiratory symptoms requiring additional treatment with systemic corticosteroids and/or antibiotics.

2.10 Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparisons between eosinophil groups were performed using Student's t-test or ANOVA for continuous variables and chi-square test for categorical variables. A p-value <0.05 was considered statistically significant.

3. Results

3.1 Study Population and Baseline Characteristics

A total of 156 patients with spirometry-confirmed COPD were included in the study and completed the follow-up period. The mean age of the participants was 62.1 ± 8.9 years, with a male predominance (74.4%). Most patients were current or former smokers (70.5%). The mean baseline FEV_1 was 49.8 ± 15.2% predicted, indicating moderate to severe airflow limitation. The mean baseline CAT score was 22.1 ± 5.4, and the mean mMRC dyspnea score was 2.4 ± 0.9.

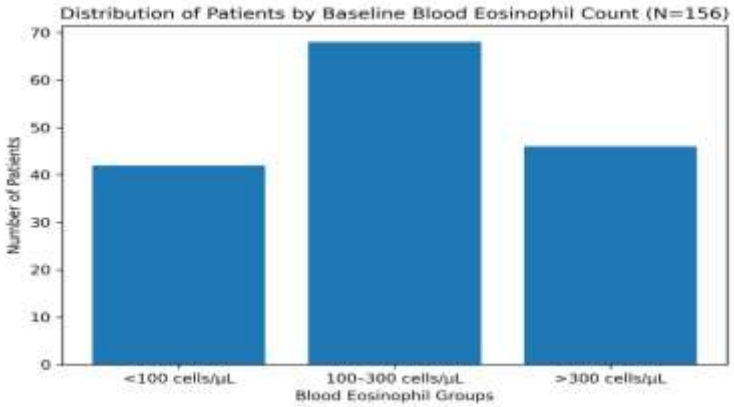
Table I. Baseline demographic and clinical characteristics

Variable	Value
Total patients	156
Age (years), mean ± SD	62.1 ± 8.9
Male, n (%)	116 (74.4%)
Female, n (%)	40 (25.6%)
Current/former smokers, n (%)	110 (70.5%)
Non-smokers, n (%)	46 (29.5%)
Duration of COPD (years), mean ± SD	7.6 ± 3.8
Baseline FEV_1 (% predicted), mean ± SD	49.8 ± 15.2
Baseline CAT score, mean ± SD	22.1 ± 5.4
Baseline mMRC score, mean ± SD	2.4 ± 0.9
Blood eosinophil count (cells/µL), mean ± SD	246 ± 134

3.2 Distribution of Blood Eosinophil Counts

Patients were categorized into three groups according to baseline blood eosinophil levels. Baseline characteristics such as age, smoking status, and baseline lung function were comparable across the three eosinophil groups (p >0.05).

Figure I: Distribution of patients by baseline blood eosinophil count



3.3 Change in Lung Function Following ICS Therapy

During the 6-month follow-up, improvement in lung function was observed in all groups receiving ICS therapy. However, patients with higher baseline eosinophil counts showed significantly greater improvement. ANOVA analysis demonstrated a significant difference in lung function improvement among the three groups ($p < 0.01$).

Table II. Change in FEV_1 after ICS therapy

Eosinophil group	Baseline FEV_1 (% predicted)	Follow-up FEV_1 (% predicted)	Mean improvement (mL)	p-value
<100 cells/µL	48.9 ± 14.8	50.6 ± 14.3	38 ± 32	
100–300 cells/µL	50.1 ± 15.6	54.2 ± 15.0	74 ± 40	
>300 cells/µL	50.4 ± 15.1	57.8 ± 14.6	128 ± 47	<0.01

3.4 Symptom Improvement

Patients with higher eosinophil counts showed greater improvement in symptoms, as indicated by a larger reduction in CAT scores.

Table III. Change in CAT score after treatment

Eosinophil group	Baseline CAT score	Follow-up CAT score	Mean reduction	p-value
<100 cells/µL	21.9 ± 5.2	19.6 ± 4.8	2.3 ± 1.6	
100–300 cells/µL	22.3 ± 5.6	18.0 ± 5.0	4.3 ± 1.9	
>300 cells/µL	22.4 ± 5.3	15.8 ± 4.7	6.6 ± 2.2	<0.05

3.5 Exacerbation Frequency

The rate of COPD exacerbations during follow-up was significantly lower in patients with higher eosinophil counts receiving ICS therapy.

Table IV. Exacerbation rates during follow-up

Eosinophil group	Mean exacerbations	Severe exacerbations requiring hospitalization	p-value
<100 cells/µL	2.0 ± 0.9	16 (38.1%)	
100–300 cells/µL	1.4 ± 0.7	15 (22.1%)	
>300 cells/µL	0.9 ± 0.5	6 (13.0%)	<0.01

3.6 Correlation Analysis

A moderate positive correlation was observed between baseline blood eosinophil count and improvement in FEV_1 ($r = 0.44$, $p < 0.01$).

A negative correlation was observed between eosinophil count and annual exacerbation rate ($r = -0.39$, $p < 0.01$).

3.7 Multivariate Analysis

Multivariate logistic regression analysis adjusting for age, smoking status, baseline lung function, and prior exacerbation history identified baseline eosinophil count >300 cells/µL as an independent predictor of improved response to ICS therapy.

Table V. Multivariate predictors of response to ICS therapy

Variable	Odds Ratio (OR)	95% CI	p-value
Eosinophil count >300 cells/µL	3.1	1.7 – 5.6	<0.001
Smoking status	1.3	0.8 – 2.4	0.18
Baseline FEV_1	1.1	0.9 – 1.5	0.22
Previous exacerbations	1.8	1.2 – 2.9	0.03

Overall, the findings demonstrate that higher baseline blood eosinophil counts are associated with greater clinical benefit from ICS therapy in COPD patients**,** including improved lung function, better symptom control, and reduced exacerbation rates.

4. Discussion

The present study evaluated the role of baseline blood eosinophil count as a predictor of response to inhaled corticosteroid (ICS) therapy in patients with COPD. Our findings demonstrated that patients with higher eosinophil counts (>300 cells/μL) experienced greater improvement in lung function, better symptom control, and a lower frequency of exacerbations compared with patients with lower eosinophil levels. These results support the increasing recognition of blood eosinophils as a useful biomarker for guiding ICS therapy in COPD.

In the present study, patients with higher eosinophil counts showed greater improvement in FEV_1 following ICS therapy. This finding is consistent with previous studies reporting that eosinophilic airway inflammation identifies a subgroup of COPD patients who respond better to corticosteroid treatment (9). Similarly, post-hoc analyses of large COPD trials have demonstrated that higher blood eosinophil levels are associated with improved response to ICS-containing regimens (10). Kwok et al. also reported that blood eosinophil levels can predict clinical response to ICS therapy in COPD patients (11).

Our study also demonstrated a greater reduction in symptom burden (CAT score) among patients with elevated eosinophil counts. Similar findings have been reported in recent studies indicating that eosinophilic COPD phenotypes show better clinical outcomes with ICS treatment (12). Dhawan et al. further suggested that combining biomarkers such as blood eosinophils and fractional exhaled nitric oxide may enhance the prediction of steroid responsiveness in COPD (13).

Another important finding of this study was the significant reduction in exacerbation rates among patients with higher eosinophil counts receiving ICS therapy. This observation is consistent with recent systematic reviews that have identified blood eosinophil count as an important predictor of exacerbation risk and ICS responsiveness in COPD (14). Chen et al. similarly reported that eosinophil counts above 300 cells/μL were associated with an increased risk of exacerbations but also a greater benefit from ICS therapy (15).

The findings of the present study are also consistent with the Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommendations, which emphasize the role of blood eosinophil counts in guiding the initiation or escalation of ICS therapy in COPD patients with frequent exacerbations (16). GOLD guidelines suggest that patients with higher eosinophil counts derive greater clinical benefit from ICS-containing regimens, whereas those with very low eosinophil counts may have limited benefit and a higher risk of adverse effects (17).

Recent research has also highlighted the potential role of eosinophils in precision medicine approaches for COPD, where biomarkers are used to individualize therapy and improve treatment outcomes (18,19).

Despite these findings, the present study has certain limitations. Being a single-center observational study, the results may not be generalizable to all populations. Additionally, other inflammatory biomarkers such as sputum eosinophils were not evaluated. Larger multicenter studies may further clarify the role of eosinophils in guiding COPD treatment.

Overall, the present study supports the use of baseline blood eosinophil count as a practical and accessible biomarker for predicting response to ICS therapy in COPD, which may help clinicians optimize treatment strategies and improve patient outcomes

5. Conclusion

This study demonstrates that baseline blood eosinophil count is a useful biomarker for predicting response to inhaled corticosteroid (ICS) therapy in patients with COPD. Patients with higher eosinophil counts (>300 cells/μL) showed greater improvement in lung function, better symptom control, and fewer exacerbations compared with those with lower eosinophil levels. These findings support the use of blood eosinophil measurement as a simple and practical tool to guide individualized COPD management and optimize the use of ICS therapy.

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