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Correlation of Serum Eosinophil Count with Severity and Treatment Response in COPD

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a heterogeneous respiratory disorder characterized by persistent airflow limitation, chronic inflammation, and variable response to therapy. Blood eosinophil count has emerged as an important biomarker for identifying eosinophilic COPD phenotype and predicting response to corticosteroid-based treatment. The present study was conducted to evaluate the correlation between serum eosinophil count, COPD severity, and treatment response among patients with COPD.

Methods: This prospective observational study included 110 patients diagnosed with COPD. All patients underwent detailed clinical evaluation, spirometry, and peripheral blood eosinophil estimation. COPD severity was assessed according to GOLD criteria, along with symptom assessment using standardized clinical parameters. Patients were followed after initiation of standard COPD therapy, and treatment response was evaluated based on changes in lung function, symptom scores, and exacerbation frequency. The association between serum eosinophil count and clinical outcomes was analyzed using appropriate statistical methods.

Results: The mean age of study participants was 61.8 ± 8.7 years, with male predominance (89.1%). The mean serum eosinophil count was 238.6 ± 156.4 cells/µL, and 31.8% of patients had eosinophil levels >300 cells/µL. Serum eosinophil count showed a significant correlation with FEV_1 ($r=0.34$, $p<0.001$) and symptom severity assessed by CAT score ($r=-0.29$, $p=0.002$). Patients with eosinophilic COPD demonstrated higher FEV_1 values and fewer exacerbations compared with non-eosinophilic patients. Following treatment, significant improvement was observed in FEV_1, CAT score, mMRC score, and exacerbation frequency, with greater clinical improvement among patients with higher eosinophil levels.

Conclusion: Serum eosinophil count serves as a valuable biomarker for COPD phenotyping and prediction of treatment response. Incorporation of eosinophil assessment into routine COPD evaluation may facilitate personalized therapy selection and improve clinical outcomes.

Keywords: Chronic obstructive pulmonary disease; Blood eosinophil count; Eosinophilic phenotype; COPD severity; Treatment response; Inhaled corticosteroids; Biomarker.

Introduction

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable respiratory disorder characterized by persistent airflow limitation and chronic respiratory symptoms due to abnormalities of the airways and alveolar structures. It represents a major global health burden, contributing significantly to morbidity, mortality, healthcare utilization, and reduced quality of life.[1] The prevalence of COPD continues to rise worldwide due to increasing exposure to risk factors such as tobacco smoke, biomass fuel exposure, air pollution, occupational hazards, and an aging

population. Despite advances in diagnosis and treatment, COPD remains a heterogeneous disease with considerable variability in clinical presentation, disease progression, inflammatory characteristics, exacerbation frequency, and response to therapy.[2] The pathogenesis of COPD involves complex interactions between chronic airway inflammation, oxidative stress, immune dysregulation, mucus hypersecretion, airway remodeling, and destruction of lung parenchyma. Although COPD has traditionally been considered a predominantly neutrophilic inflammatory disease, recent evidence has identified distinct inflammatory phenotypes, including eosinophilic inflammation.[3] A subset of COPD patients demonstrates increased eosinophilic airway inflammation, which is associated with higher exacerbation risk and differential response to corticosteroid therapy. Recognition of these inflammatory phenotypes has led to a shift toward personalized COPD management based on individual biological characteristics. Peripheral blood eosinophil count has emerged as a simple, reproducible, and clinically accessible biomarker for identifying patients with eosinophilic COPD phenotype. [4,5] Blood eosinophils reflect systemic eosinophilic activity and show a moderate correlation with airway eosinophilic inflammation. Compared with invasive methods such as sputum eosinophil assessment, serum eosinophil estimation is easy to perform and can be incorporated into routine clinical practice for risk assessment and therapeutic decision-making. The role of blood eosinophil count in predicting response to inhaled corticosteroid (ICS) therapy has gained considerable attention. Clinical trials and meta-analyses have demonstrated that patients with higher eosinophil counts derive greater benefit from ICS-containing treatment regimens, particularly in reducing the frequency of COPD exacerbations.[6] The therapeutic response increases with rising eosinophil thresholds, with significant benefits observed among patients with eosinophil levels above 100 cells/µL and greater effects in those exceeding 300 cells/µL. Therefore, current COPD management guidelines incorporate blood eosinophil count as an important biomarker for guiding ICS use, especially among patients with frequent exacerbations.[7] COPD severity is traditionally assessed using spirometric parameters, particularly forced expiratory volume in the first second (FEV_1), symptom burden, exercise capacity, and exacerbation history. However, airflow limitation alone does not fully represent the complex biological behavior of COPD.[8] Inflammatory biomarkers such as serum eosinophil count may provide additional information regarding disease phenotype, severity, exacerbation susceptibility, and treatment response. Elevated eosinophil levels may identify a subgroup of patients with increased inflammatory activity who are more likely to respond to corticosteroid-based therapies.[9] Exacerbations represent major events in the natural history of COPD and contribute to accelerated lung function decline, increased hospitalization, and higher mortality. Identification of biomarkers capable of predicting exacerbation risk and therapeutic response is therefore essential for improving clinical outcomes.[10] Although several studies have reported associations between elevated blood eosinophil levels, increased exacerbation risk, and improved corticosteroid responsiveness, variations in study populations, eosinophil thresholds, and clinical outcomes have resulted in inconsistent findings. Recent advances in COPD research have further highlighted the importance of type 2 inflammatory pathways in selected patients with eosinophilic COPD. Targeted therapies against eosinophil-associated pathways, including interleukin (IL)-5 and IL-4/IL-13 signaling pathways, have shown promising results in reducing exacerbations among patients with persistent eosinophilic inflammation despite optimized inhaled therapy.[11] These developments emphasize the importance of accurate identification of eosinophilic phenotypes for personalized treatment strategies. Although blood eosinophil count has established value in guiding COPD therapy, its correlation with disease severity and treatment response requires further evaluation in different clinical settings. Understanding this relationship may improve patient stratification, optimize treatment selection, and reduce unnecessary corticosteroid exposure.[12] Therefore, the present study, "Correlation of Serum Eosinophil Count with Severity and Treatment Response in COPD," aims to evaluate the association between serum eosinophil levels, COPD severity, and treatment response among patients with COPD. The findings may contribute to improved phenotyping and individualized management strategies for COPD patients.

Methodology:

The present study was conducted as a prospective observational study to evaluate the correlation between serum eosinophil count, severity of chronic obstructive pulmonary disease (COPD), and treatment response among patients with COPD. A total of 110 patients diagnosed with COPD were included in the study.

Inclusion Criteria

Patients fulfilling the following criteria were included in the study:

- Patients aged ≥40 years.
- Patients diagnosed with COPD according to clinical features and spirometric criteria.
- Patients with post-bronchodilator FEV_1/FVC ratio <0.70 on spirometry.

- Patients who were clinically stable or presenting with COPD symptoms as per study protocol.
- Patients willing to provide written informed consent.

Exclusion Criteria

Patients with the following conditions were excluded:

- Patients with a history of bronchial asthma or asthma-COPD overlap.
- Patients with active respiratory infections at the time of enrollment.
- Patients with pulmonary tuberculosis or other active pulmonary diseases.
- Patients with malignancy or significant immunological disorders.
- Patients receiving systemic corticosteroids or immunosuppressive therapy before evaluation.
- Patients unwilling to participate or lost to follow-up.

Clinical Assessment

All enrolled patients underwent detailed clinical evaluation, including demographic characteristics, smoking history, occupational exposure, duration of COPD, clinical symptoms, previous history of exacerbations, and medication history. The severity of COPD symptoms was assessed using standardized clinical assessment tools, including the modified Medical Research Council (mMRC) dyspnea scale and COPD Assessment Test (CAT) score.

A history of previous COPD exacerbations, including frequency of exacerbations and hospitalization within the previous year, was recorded. Baseline clinical parameters, including respiratory rate, oxygen saturation, and physical examination findings, were documented.

Assessment of COPD Severity

COPD severity was assessed using pulmonary function testing. Spirometry was performed according to standardized guidelines, and post-bronchodilator values were recorded. Parameters including forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC), and FEV_1/FVC ratio were assessed.

Patients were categorized into COPD severity groups based on spirometric classification according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria.

Estimation of Serum Eosinophil Count

Peripheral venous blood samples were collected from all participants at baseline evaluation. Complete blood count analysis was performed using an automated hematology analyzer, and absolute eosinophil count was recorded.

Serum eosinophil count was expressed as cells/µL. Patients were categorized into eosinophilic and non-eosinophilic groups based on predefined eosinophil thresholds. The association between eosinophil count and clinical severity parameters was evaluated.

Treatment and Follow-Up Assessment

All patients received standard COPD management according to current clinical guidelines, including appropriate inhaled bronchodilator therapy with or without inhaled corticosteroids based on clinical assessment.

Patients were followed up after initiation or modification of therapy to assess treatment response. Clinical improvement was evaluated based on changes in symptom scores, exacerbation frequency, respiratory symptoms, and pulmonary function parameters.

Treatment response was assessed by comparing baseline and follow-up clinical parameters, including mMRC score, CAT score, FEV_1 values, and exacerbation status.

Outcome Measures

The primary outcome measures of the study were:

- Correlation between serum eosinophil count and COPD severity.
- Association between serum eosinophil count and treatment response.
- Secondary outcome measures included:
- Relationship between eosinophil count and frequency of COPD exacerbations.
- Association of eosinophil count with spirometric parameters.
- Comparison of clinical outcomes between eosinophilic and non-eosinophilic COPD groups.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS.21 statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on data distribution. Categorical variables were expressed as frequency and percentage.The normality of continuous variables was assessed using the Shapiro–Wilk test. Comparison between groups was performed using the independent Student's t-test or Mann–Whitney U test for continuous variables and Chi-square test or Fisher's exact test for categorical variables.

Correlation between serum eosinophil count and clinical parameters, including FEV_1, CAT score, mMRC score, and exacerbation frequency, was

assessed using Pearson's or Spearman's correlation analysis depending on data distribution.

A p-value <0.05 was considered statistically significant.

Results:

A total of 110 patients with chronic obstructive pulmonary disease (COPD) were included in the present study. The demographic, clinical, inflammatory, and treatment response parameters were evaluated to assess the correlation between serum eosinophil count, COPD severity, and response to therapy.

The mean age of the study population was 61.8 ± 8.7 years, with the majority of patients belonging to the 61–70 years age group (42.7%). A male predominance was observed, with 89.1% males and 10.9% females. Most patients had a significant smoking history (78.2%). The baseline characteristics of the study participants are presented in Table 1.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n=110)

Variable	Number (n)	Percentage (%)
Age group (years)		
40–50	14	12.7
51–60	32	29.1
61–70	47	42.7
>70	17	15.5
Sex		
Male	98	89.1
Female	12	10.9
Smoking status		
Current smoker	52	47.3
Former smoker	34	30.9
Non-smoker	24	21.8
Duration of COPD		
<5 years	38	34.5
5–10 years	49	44.5
>10 years	23	20.9
BMI (kg/m²)		
<18.5	18	16.4
18.5–24.9	67	60.9
≥25	25	22.7

Based on spirometry, patients were categorized according to GOLD severity classification. Majority of patients belonged to GOLD stage III (40.9%), followed by GOLD stage II (35.5%). Severe airflow limitation (GOLD III–IV) was observed in 55.5% of patients Table 2.

Table 2. Distribution of COPD Severity According to GOLD Classification (n=110)

GOLD Stage	FEV_1 (% predicted)	Number (n)	Percentage (%)
GOLD I (Mild)	≥80%	8	7.3
GOLD II (Moderate)	50–79%	39	35.5
GOLD III (Severe)	30–49%	45	40.9
GOLD IV (Very severe)	<30%	18	16.3
Total		**110**	**100**

The mean serum eosinophil count among study participants was 238.6 ± 156.4 cells/µL. Elevated eosinophil count (>300 cells/µL) was observed in 31.8% of patients, while 38.2% had eosinophil counts between 100–300 cells/µL Table 3, Figure 1

Table 3. Distribution of Serum Eosinophil Count Among COPD Patients (n=110)

Serum eosinophil count (cells/µL)	Number (n)	Percentage (%)
<100	33	30.0
100–300	42	38.2
>300	35	31.8
Mean eosinophil count	**238.6 ± 156.4**	

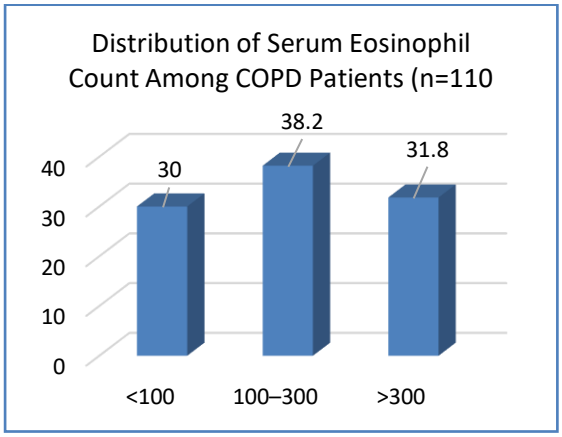

Figure 1 Distribution of Serum Eosinophil Count Among COPD Patients (n=110

Serum eosinophil count showed a significant positive correlation with FEV_1 percentage predicted ($r=0.34$, $p<0.001$) and a negative correlation with CAT score ($r=-0.29$, $p=0.002$) and exacerbation frequency ($r=-0.25$, $p=0.008$). The correlation analysis is presented in Table 4.

Table 4. Correlation Between Serum Eosinophil Count and COPD Severity Parameters (n=110)

Parameter	Correlation coefficient (r)	p-value
FEV_1 (% predicted)	0.34	<0.001
GOLD severity grade	-0.31	0.001
CAT score	-0.29	0.002
mMRC dyspnea score	-0.26	0.006
Annual exacerbation frequency	-0.25	0.008

Patients were divided into eosinophilic COPD (>300 cells/µL) and non-eosinophilic COPD (<300 cells/µL) groups. Patients with eosinophilic COPD demonstrated significantly higher mean FEV_1 values and lower exacerbation frequency compared with non-eosinophilic patients Table 5, Figure 2

Table 5. Comparison of Clinical Characteristics Between Eosinophilic and Non-Eosinophilic COPD Groups

Parameter	Eosinophilic COPD (>300 cells/µL) n=35	Non-eosinophilic COPD (<300 cells/µL) n=75	p-value
Age (years)	60.9 ± 8.2	62.2 ± 8.9	0.46
FEV_1 (%)	48.6 ± 12.4	41.2 ± 11.8	0.004
CAT score	18.3 ± 5.1	21.6 ± 6.2	0.006
mMRC score	2.1 ± 0.8	2.6 ± 0.9	0.009
Exacerbations/ year	1.4 ± 0.8	2.1 ± 1.1	0.001

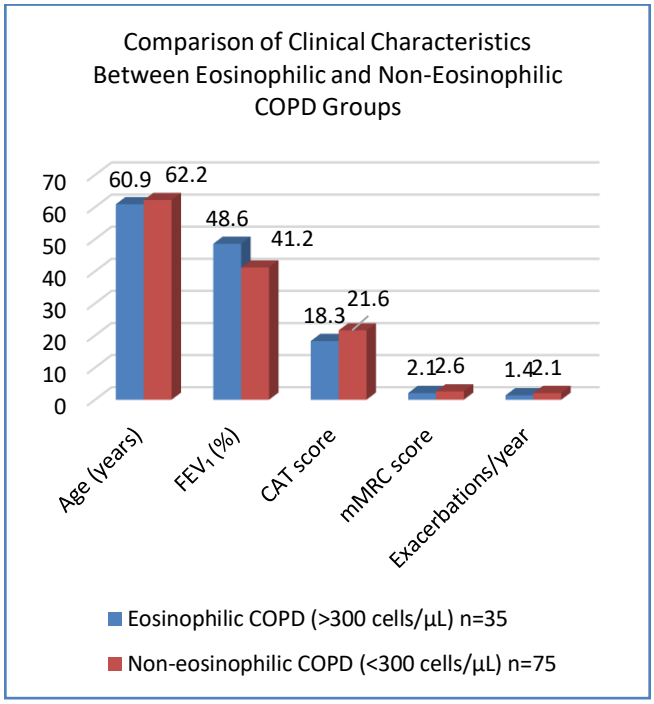

Figure 2 Comparison of Clinical Characteristics Between Eosinophilic and Non-Eosinophilic COPD Groups

Following 3 months of standard COPD therapy, significant improvement was observed in symptom scores and pulmonary function parameters. Patients with higher baseline eosinophil counts demonstrated greater improvement in FEV_1 and reduction in CAT score Table 6, Figure 3

Table 6. Treatment Response According to Baseline Serum Eosinophil Count (n=110)

Parameter	Baseline	3 Months Follow-up	p-value

FEV_1 (%)	44.1 ± 12.2	49.3 ± 13.1	<0.001
CAT score	21.2 ± 6.0	15.8 ± 5.2	<0.001
mMRC score	2.5 ± 0.9	1.8 ± 0.8	<0.001
Annualized exacerbation rate	2.0 ± 1.1	1.2 ± 0.8	0.002

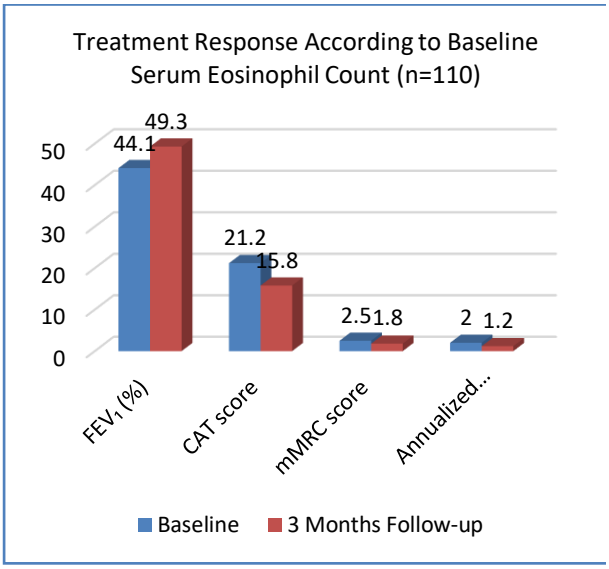

Figure 3 Treatment Response According to Baseline Serum Eosinophil Count (n=110)

Discussion

Chronic obstructive pulmonary disease (COPD) is a heterogeneous inflammatory airway disease characterized by variable clinical progression, exacerbation frequency, and response to therapy. The present study evaluated the role of serum eosinophil count as a biomarker for assessing disease severity and predicting treatment response among 110 patients with COPD. The findings demonstrated that peripheral eosinophil levels were associated with lung function parameters, symptom severity, exacerbation frequency, and response to therapy, supporting its role in COPD phenotyping and personalized management. In the present study, the mean age of patients was 61.8 ± 8.7 years, with male predominance (89.1%) and a high proportion of smokers (78.2%). Similar demographic characteristics have been reported in COPD cohorts, where increasing age, male sex, and tobacco exposure remain important contributors to chronic airway inflammation and progressive airflow limitation. The majority of patients in the present study had moderate-to-severe disease, with 40.9% classified as GOLD stage III and 16.3% as GOLD stage IV, indicating advanced airflow limitation. Although spirometry remains the cornerstone for COPD severity assessment, inflammatory biomarkers may provide additional information regarding disease phenotype and therapeutic response. The mean serum eosinophil count in the present study was 238.6 ± 156.4 cells/µL, with 31.8% of patients demonstrating eosinophil levels >300 cells/µL, representing an eosinophilic COPD phenotype. Yun et al. [13] evaluated blood eosinophil thresholds in COPDGene (n=1553) and ECLIPSE (n=1895) cohorts and reported that eosinophil counts ≥300 cells/µL were associated with increased exacerbation risk, with adjusted incidence rate ratios of 1.32 and 1.22, respectively. These findings support the clinical relevance of elevated eosinophil thresholds in COPD assessment. The present study demonstrated a significant correlation between serum eosinophil count and COPD-related parameters. Higher eosinophil levels showed a positive correlation with FEV_1 ($r=0.34$, $p<0.001$) and a negative correlation with CAT score ($r=-0.29$, $p=0.002$), suggesting that eosinophilic COPD represents a distinct inflammatory phenotype with different clinical behavior and treatment responsiveness. Previous studies have suggested that blood eosinophils act primarily as a predictive biomarker for therapeutic response rather than a direct marker of airflow limitation severity. Patients with eosinophilic COPD (>300 cells/µL) in the present study demonstrated significantly higher FEV_1 values (48.6 ± 12.4% vs 41.2 ± 11.8%, $p=0.004$), lower CAT scores (18.3 ± 5.1 vs 21.6 ± 6.2, $p=0.006$), and fewer annual exacerbations (1.4 ± 0.8 vs 2.1 ± 1.1, $p=0.001$) compared with non-eosinophilic patients. These findings are consistent with previous studies showing that patients with higher eosinophil levels derive greater benefit from corticosteroid-based therapies. The role of blood eosinophils in predicting inhaled corticosteroid (ICS) response has been demonstrated in several clinical trials. The WISDOM trial showed that withdrawal of ICS increased exacerbation risk, particularly among patients with higher eosinophil counts, supporting the continued benefit of corticosteroid therapy in eosinophilic COPD patients. Similarly, pooled analyses of randomized trials have demonstrated greater reductions in exacerbations with ICS therapy among patients with increasing blood eosinophil levels. In the present study, treatment response after 3 months showed significant improvement in FEV_1 (44.1 ± 12.2% to 49.3 ± 13.1%, $p<0.001$), CAT score (21.2 ± 6.0 to 15.8 ± 5.2, $p<0.001$), mMRC score (2.5 ± 0.9 to 1.8 ± 0.8, $p<0.001$), and exacerbation frequency (2.0 ± 1.1 to 1.2 ± 0.8, $p=0.002$). Patients with higher baseline eosinophil counts showed greater clinical improvement, supporting the predictive value of eosinophils for identifying corticosteroid-responsive COPD phenotypes. Bafadhel et al. [14]

demonstrated that eosinophil-guided corticosteroid therapy could optimize steroid use during COPD exacerbations while maintaining clinical outcomes. Recent biologic therapy trials have further emphasized the importance of eosinophilic phenotyping. The ABRA trial showed that benralizumab reduced treatment failure among patients with eosinophilic exacerbations compared with standard therapy, with a reported odds ratio of 0.26 (95% CI 0.12–0.57). However, eosinophil count alone may not completely predict disease outcomes. A pooled analysis of 11 randomized COPD trials involving 22,125 patients demonstrated that although eosinophil levels strongly predicted ICS responsiveness, their association with future exacerbation risk was modest, highlighting the need to interpret eosinophil values along with exacerbation history, symptoms, and spirometric findings. Overall, the present study supports serum eosinophil count as a useful biomarker for COPD phenotyping, severity assessment, and prediction of treatment response. Incorporating blood eosinophil measurement into routine COPD evaluation may facilitate individualized therapy selection, optimize corticosteroid use, and improve long-term clinical outcomes.

Conclusion

Serum eosinophil count was found to be a useful biomarker for phenotyping COPD patients and assessing their clinical response to therapy. Higher eosinophil levels were associated with better lung function parameters, reduced symptom burden, and improved response to corticosteroid-based treatment. Measurement of blood eosinophil count may assist in identifying patients who are more likely to benefit from individualized anti-inflammatory therapies. Incorporation of eosinophil assessment along with clinical and spirometric parameters may help optimize COPD management and improve patient outcomes.

Limitations

The study was conducted with a relatively limited sample size of 110 patients and from a single center, which may restrict the generalizability of the findings. The follow-up duration was limited, preventing assessment of long-term outcomes such as disease progression and mortality. Variations in eosinophil levels over time and the influence of other inflammatory factors were not evaluated. Larger multicentric studies with longer follow-up are required to validate the role of serum eosinophil count in COPD management.

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