RESEARCH PAPER

Association Between Induced Sputum Eosinophils and Asthma Severity Assessed by the Asthma Control Test: A Cross-Sectional Study

Dr. Akshaya S[1], Dr. Elen Ann Abraham[2*], Dr. Ghanshyam Verma[3]

[1] Post Graduate, Department of Respiratory Medicine, SBMCH, India.

[2] Associate Professor, Department of Respiratory Medicine, SBMCH, India.

[3] Professor & Head of Department, Department of Respiratory Medicine, SBMCH, India.

ABSTRACT

Background

Eosinophilic airway inflammation is a key mechanism in asthma and is closely linked with inadequate disease control. The percentage of eosinophils in induced sputum is widely regarded as the reference method for assessing airway inflammation; however, its relationship with symptom-based control tools such as the Asthma Control Test (ACT) requires further clarification.

Objectives

To evaluate the association between induced sputum eosinophil percentage and asthma severity as determined by ACT.

Methods

This hospital-based cross-sectional study included 100 adults with spirometry-confirmed asthma. Asthma control status was classified using ACT. Induced sputum samples were obtained using hypertonic saline and analyzed after cytospin preparation. Differences between ACT groups were examined using one-way ANOVA. Pearson's correlation coefficient assessed associations, and receiver operating characteristic (ROC) analysis determined predictive performance.

Results

Mean sputum eosinophil percentage rose significantly with worsening asthma control (2.1 ± 1.0% in well-controlled vs 6.8 ± 2.7% in poorly controlled; $p < 0.001$). A strong inverse correlation was observed between sputum eosinophils and ACT score ($r = -0.68$, $p < 0.001$). ROC analysis showed good discrimination for poorly controlled asthma (AUC = 0.88) with an optimal cut-off ≥4.5% (sensitivity 82%, specificity 81%).

Conclusion

Induced sputum eosinophilia demonstrates a strong inverse association with ACT-defined asthma control and remains a dependable marker of disease severity. Incorporating airway inflammatory assessment may improve individualized asthma management.

Keywords: Asthma; sputum eosinophils; Asthma Control Test; airway inflammation; severity

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INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways characterized by variable respiratory symptoms and fluctuating airflow limitation. Increasing attention has been directed toward inflammatory phenotyping, particularly eosinophilic asthma, which is associated with poor symptom control, increased exacerbation risk, and favorable response to corticosteroid therapy.[1–3]

Although patient-reported tools such as the Asthma Control Test (ACT) are widely used in routine practice, they primarily reflect symptom burden and may not accurately represent the underlying airway inflammatory status. Measurement of eosinophils in induced sputum provides a direct evaluation of airway inflammation and is considered the reference standard for identifying eosinophilic asthma.[3]

In many resource-limited settings, treatment decisions are largely symptom driven. Understanding how sputum eosinophilia relates to ACT-defined control may therefore assist in better risk stratification and more targeted therapeutic decisions.

Aim: To assess the association between induced sputum eosinophil percentage and asthma severity using ACT.

MATERIALS AND METHODS

Study design and setting

A cross-sectional observational study was conducted at a tertiary care teaching hospital in Chennai.

Study population

A total of 100 adults aged 18–65 years with spirometry-confirmed bronchial asthma were enrolled according to standard reversibility criteria.[1] Eligible patients were recruited consecutively after obtaining written informed consent.

Asthma control assessment

Asthma control was categorized using ACT:

- Well controlled: 20–25
- Not well controlled: 16–19
- Poorly controlled: 5–15

Induced sputum analysis

Sputum induction was performed using 4.5% hypertonic saline nebulization. Samples were processed with dithiothreitol, followed by cytospin preparation and May–Grünwald–Giemsa staining. An eosinophil proportion ≥3% was considered indicative of eosinophilic airway inflammation.[3]

Statistical analysis

Data were analyzed using SPSS version 25. Continuous variables are presented as mean ± SD. Group comparisons were performed using one-way ANOVA. Pearson's correlation coefficient was used to examine associations. ROC analysis evaluated predictive accuracy. A p value <0.05 was considered statistically significant.

RESULTS

Baseline characteristics

The mean age of participants was 41.3 ± 11.2 years, with females comprising 56% of the cohort. Most patients demonstrated suboptimal asthma control at presentation.

Asthma control distribution

According to ACT:

- Well controlled: 32%
- Not well controlled: 38%
- Poorly controlled: 30%

Primary outcome

Mean induced sputum eosinophil percentage showed a progressive increase across worsening ACT categories:

ACT category	Mean ± SD (
Well controlled	2.1 ± 1.0
Not well contro	4.3 ± 1.9
Poorly controll	6.8 ± 2.7

The difference was statistically significant ($F = 18.72$, $p < 0.001$).

Correlation analysis

A strong negative correlation was observed between sputum eosinophil percentage and ACT score ($r = -0.68$, $p < 0.001$), indicating poorer asthma control with increasing airway eosinophilia.[3]

ROC analysis

Induced sputum eosinophils demonstrated good predictive performance for poorly controlled asthma:

- AUC: 0.88
- Optimal cut-off: ≥4.5%
- Sensitivity: 82%
- Specificity: 81%

DISCUSSION

The present study demonstrates a significant inverse relationship between induced sputum eosinophil percentage and ACT-defined asthma control. The graded increase in sputum eosinophils with worsening ACT categories underscores the central contribution of eosinophilic inflammation in asthma pathophysiology.[2],[3]

The strong correlation observed in this study is consistent with earlier reports identifying sputum eosinophils as a reliable indicator of airway inflammation and corticosteroid responsiveness.[3]

Clinically, patients with sputum eosinophils ≥4.5% are more likely to have inadequate asthma control and may benefit from optimization of anti-inflammatory therapy. Biomarker-guided approaches have been shown to improve outcomes and reduce exacerbation risk.[4],[5] Higher peripheral blood eosinophil counts have also been linked to greater asthma burden in longitudinal analyses.[6]"

Limitations

- Cross-sectional design
- Single-centre experience
- Background inhaled corticosteroid exposure not fully stratified
- Limited feasibility of sputum induction in routine practice

CONCLUSION

Induced sputum eosinophil percentage demonstrates a strong inverse correlation with ACT score and remains a robust biomarker of asthma severity. Incorporation of airway inflammatory assessment may facilitate more precise and individualized asthma management.

Figures

Figure 1: ACT category distribution

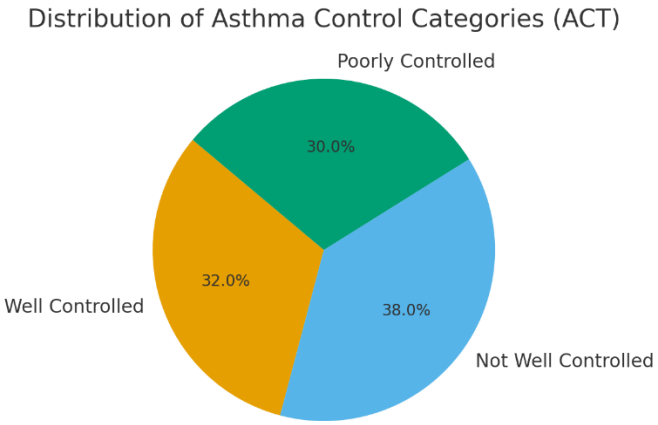
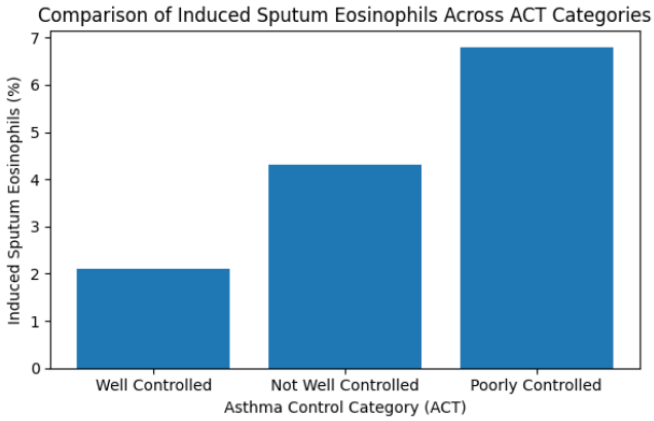


Figure 2: Comparison of sputum eosinophils across ACT groups



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