Biomarkers in the management of severe asthma: current trends and future directions.

Ahmed El-Sayed*

Faculty of Veterinary Medicine, Cairo University, Giza, Egypt

Introduction

Severe asthma remains a significant clinical challenge, affecting a small subset of patients yet accounting for a disproportionate burden of morbidity, healthcare utilization, and mortality. In recent years, the identification and application of biomarkers have transformed the landscape of asthma management, enabling more precise phenotyping and personalized therapeutic strategies.

Current Trends in Biomarker Utilization

Biomarkers such as blood eosinophil count, serum IgE levels, and fractional exhaled nitric oxide (FeNO) are now routinely used to distinguish between Type 2 (T2) high and T2-low inflammatory pathways. These biomarkers help clinicians predict treatment response and select appropriate biologic therapies. For instance, elevated blood eosinophils are associated with favorable responses to anti-IL-5 therapies like mepolizumab and benralizumab, while high FeNO indicates potential efficacy of anti-IL-4Rα therapy (dupilumab) [1, 2, 3, 4].

Sputum cytology remains the gold standard for inflammatory phenotyping but is limited by its complexity and availability. Consequently, peripheral biomarkers are preferred in routine clinical practice for their accessibility and predictive value [5,6, 7].

Emerging Biomarkers and Technologies

Emerging research is exploring novel biomarkers such as periostin, YKL-40, and exhaled breath condensate components, aiming to refine phenotype classification further. Multi-omics approaches, integrating genomic, transcriptomic, proteomic, and metabolomic data, are also gaining traction, promising to uncover complex molecular endotypes of asthma [8, 9, 10].

Additionally, artificial intelligence (AI) and machine learning models are being developed to analyze large biomarker datasets, which may enhance prediction accuracy for exacerbation risk and therapy responsiveness.

Conclusion

Biomarkers are reshaping the clinical approach to severe asthma, moving toward a more personalized and precise medicine paradigm. Continued research and technological innovations hold promise for optimizing care and reducing the global burden of this complex respiratory disease.

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***Correspondence to:** Ahmed El-Sayed. Faculty of Veterinary Medicine, Cairo University, Giza, Egypt, E-mail: a.elsayed@cu.edu.eg

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