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MODERN APPROACHES TO THE TREATMENT OF BRONCHIAL ASTHMA: FOCUS ON PERSONALIZED THERAPY

Abstract

Bronchial asthma is a chronic inflammatory disease of the airways characterized by variable airflow obstruction and bronchial hyperresponsiveness. Despite significant advances in pharmacological therapy, asthma control remains suboptimal in a considerable number of patients. Recent developments in personalized medicine have shifted asthma management from a "one-size-fits-all" approach to individualized treatment strategies based on clinical phenotypes, inflammatory endotypes, and genetic and environmental factors. This article reviews modern approaches to the treatment of bronchial asthma with a particular focus on personalized therapy, including biomarker-driven treatment selection, targeted biologic agents, and individualized management plans aimed at improving disease control and patient outcomes.

Keywords: bronchial asthma, personalized therapy, biologic agents, airway inflammation, phenotypes

Introduction

Bronchial asthma is a major global health problem affecting more than 300 million people worldwide. It is associated with significant morbidity, reduced quality of life, and substantial healthcare costs. Asthma is no longer considered a single disease but rather a heterogeneous condition with diverse clinical presentations, underlying inflammatory mechanisms, and responses to treatment.

Traditional asthma management has relied on stepwise pharmacological therapy using inhaled corticosteroids (ICS), long-acting β_2-agonists (LABA), and short-acting bronchodilators. However, many patients continue to experience poor symptom control, frequent exacerbations, and progressive decline in lung function. This has led to increasing interest in personalized

therapy, which aims to tailor treatment according to individual patient characteristics, disease phenotypes, and molecular mechanisms.

Pathophysiology of Bronchial Asthma

Asthma is characterized by chronic inflammation of the airways involving multiple cell types, including eosinophils, mast cells, T-lymphocytes, macrophages, and neutrophils. The inflammatory process leads to airway edema, mucus hypersecretion, bronchial smooth muscle contraction, and structural airway remodeling.

Two major inflammatory endotypes are commonly described:

Type 2 (T2-high) asthma, associated with eosinophilic inflammation, elevated IgE levels, and increased interleukins such as IL-4, IL-5, and IL-13.

Non–Type 2 (T2-low) asthma, often characterized by neutrophilic or paucigranulocytic inflammation and poor response to corticosteroids.

Understanding these mechanisms is essential for selecting appropriate personalized treatment strategies.

Clinical Phenotypes of Asthma

Asthma phenotypes describe observable clinical characteristics and include:

Allergic (atopic) asthma

Non-allergic asthma

Late-onset asthma

Obesity-related asthma

Exercise-induced asthma

Phenotyping helps clinicians predict disease course, response to therapy, and risk of exacerbations, thereby guiding individualized management.

Conventional Pharmacological Treatment

Standard asthma therapy follows international guidelines such as GINA and includes:

Inhaled corticosteroids (ICS) as the cornerstone of anti-inflammatory treatment

β_2-agonists (SABA and LABA) for bronchodilation

Leukotriene receptor antagonists (LTRAs) as add-on therapy

Theophylline in selected cases

While effective in many patients, conventional therapy does not adequately control asthma in all individuals, particularly those with severe or refractory disease.

Personalized Therapy in Bronchial Asthma

Personalized therapy aims to optimize treatment by considering individual variability in disease mechanisms and treatment response.

Biomarkers in Personalized Asthma Management

Biomarkers play a crucial role in identifying asthma endotypes and guiding therapy:

Blood eosinophil count

Fractional exhaled nitric oxide (FeNO)

Serum total and specific IgE

Sputum eosinophils

These markers help select patients who are likely to benefit from targeted therapies.

Biologic Agents in Asthma Treatment

Biologic therapies represent a major breakthrough in personalized asthma management, particularly for severe T2-high asthma.

Anti-IgE Therapy

Omalizumab is used in patients with severe allergic asthma and elevated IgE levels.

It reduces exacerbation frequency and improves symptom control.

Anti-IL-5 and Anti-IL-5 Receptor Therapies

Mepolizumab, Reslizumab, Benralizumab

Target eosinophilic inflammation and are effective in patients with high eosinophil counts.

Anti-IL-4/IL-13 Therapy

Dupilumab

Inhibits IL-4 and IL-13 signaling, improving lung function and reducing exacerbations.

Non-Pharmacological Personalized Approaches

Personalized asthma management also includes non-drug strategies:

Identification and avoidance of individual triggers

Patient education and self-management plans

Inhaler technique optimization

Weight reduction in obese patients

Management of comorbidities such as allergic rhinitis and gastroesophageal reflux disease

Benefits and Challenges of Personalized Therapy

Benefits

Improved asthma control

Reduced exacerbation rates

Decreased corticosteroid exposure

Better quality of life

Challenges

High cost of biologic agents

Limited availability in low-resource settings

Need for specialized diagnostic tests

Future Perspectives

Advances in genomics, proteomics, and artificial intelligence are expected to further refine personalized asthma therapy. Precision medicine approaches may enable earlier intervention, prediction of treatment response, and development of novel targeted therapies.

Conclusion

Modern asthma management is undergoing a paradigm shift toward personalized therapy. Understanding asthma heterogeneity, identifying clinical phenotypes and inflammatory endotypes, and utilizing biomarkers and biologic agents allow clinicians to tailor treatment to individual patients. Personalized therapy offers significant potential to improve asthma outcomes and represents the future direction of asthma care.

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