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MODERN LABORATORY DIAGNOSTICS OF BRONCHIAL ASTHMA

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Abstract
According to the World Health Organization (WHO). Modern laboratory diagnostics play a crucial role in assessing disease severity, identifying its etiology, and monitoring treatment effectiveness. This article provides a detailed overview of methods for detecting inflammation biomarkers, specific IgE, eosinophils, fractional exhaled nitric oxide (FeNO), and the role of genetic studies. Recent advancements and their significance in a personalized approach to asthma management are discussed.

Keywords: Bronchial asthma, laboratory diagnostics, specific IgE, eosinophilia, FeNO, biomarkers, genetic studies, inflammation.

Introduction

Bronchial asthma is a chronic inflammatory disease of the airways characterized by bronchial hyperreactivity, obstruction, and episodes of dyspnea. According to WHO data from 2023, BA remains one of the leading causes of chronic disability, particularly in low- and middle-income countries.

The complexity of BA diagnosis lies in its polymorphic nature: allergic and non-allergic forms of BA require different diagnostic approaches. This necessitates the use of comprehensive methods, including blood tests, sputum analysis, functional tests, and genetic diagnostics.

1. Blood Analysis: The Role of Specific IgE. Testing for specific IgE is the gold standard for diagnosing allergic BA. It helps detect sensitization to specific allergens.

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Techniques: Methods include enzyme-linked immunosorbent assay (ELISA), radioallergosorbent test (RAST), and chemiluminescent analysis.

Reference values: Total IgE: **up to 100 IU/ml** (adults), **up to 200 IU/ml** (children). Specific IgE: levels above **0.35 kU/L** indicate allergen sensitization.

Advantages: High accuracy. Ability to test multiple allergens simultaneously (allergen panels).

Recent Studies: New allergen panels include molecular diagnostic components that identify specific allergen proteins (e.g., Der p 1 and Der p 2 for house dust mites).

2. Eosinophilic Profile: Eosinophilic inflammation is a key mechanism in the pathogenesis of BA.

Diagnostic methods:

Complete blood count: Eosinophils >300 cells/μL.

Sputum analysis: Eosinophils >3% of total cellular composition.

Additional tests: Flow cytometry is used in advanced laboratories to precisely assess blood cell profiles.

Emerging Markers: Recent studies focus on eosinophil-associated proteins such as MBP (Major Basic Protein) and ECP (Eosinophil Cationic Protein), which correlate with asthma severity.

3. Fractional Exhaled Nitric Oxide (FeNO)

FeNO is a simple, non-invasive method to assess airway inflammation.

Technology: Specialized equipment measures NO concentration in exhaled air.

Reference values: <25 ppb — normal. **25–50 ppb** — moderate inflammation. **>50 ppb** — significant inflammation.

Clinical application: FeNO is used to: Optimize inhaled corticosteroid doses. Monitor treatment effectiveness.

4. Biomarkers of Inflammation: Biomarkers provide an objective assessment of the inflammatory response in BA.

5. Key biomarkers:

Cytokines: IL-4, IL-5, IL-13.

High-sensitivity C-reactive protein (hs-CRP): Normal levels are <1 mg/L.

Periostin: A marker of eosinophilic airway inflammation.

Future Directions: Multi-omics technologies (genomics, proteomics) are actively being used to identify new biomarkers for differentiating BA subtypes.

5. Genetic Studies: Genetics not only identifies predisposition but also refines prognosis and treatment plans.

Genes under study:

IL4R: Influences IgE levels.

ADRB2: Associated with β2-agonist responsiveness.

GATA3: Linked to eosinophilic inflammation.

Techniques: Polymerase chain reaction (PCR).Next-generation sequencing (NGS).

Advantages: Genetic tests enable the development of targeted therapies for specific mutations.

6. Combined Approach: Combining multiple diagnostic methods provides a more accurate classification of the disease:

- **Allergic BA:** Confirmed by elevated specific IgE and eosinophilia.
- **Non-allergic BA:** Characterized by normal IgE levels but with eosinophilic inflammation.

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Conclusion

Modern laboratory diagnostics of bronchial asthma encompass a wide range of methods, from biomarker analysis and FeNO measurements to genetic studies. The use of these technologies not only clarifies the diagnosis but also enables therapy to be tailored to individual patient characteristics.

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