JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH
Volume 4, Issue 4, May 2026 Online ISSN: 3030-3508
https://spaceknowladge.com

COMBINED CLINICAL AND THERAPEUTIC FEATURES OF OBSTRUCTIVE AIRWAY DISEASES, BRONCHIAL ASTHMA AND METABOLIC SYNDROME: FOCUS ON INTEGRATED TREATMENT STRATEGIES

Akhmedova Gulchehra Abdullayevna
PhD, Acting Associate Professor, Department of Internal Medicine No.1, Samarkand State Medical University
Kholjigitova Mukhayyo Berdikulovna
DSc, Associate Professor, Department of Internal Diseases No.4, Samarkand State Medical University

ARTICLE INFORMATION

ARTICLE HISTORY:
Received:01.05.2026
Revised: 02.05.2026
Accepted:03.05.2026

KEYWORDS:
Obstructive airway diseases, bronchial asthma, metabolic syndrome, systemic inflammation, airway hyperresponsiveness, insulin resistance, oxidative stress, asthma phenotypes, asthma endotypes, cytokines, IL-4, IL-5, IL-6, IL-13, TNF-α

ABSTRACT:

Obstructive airway diseases, including bronchial asthma and chronic obstructive pulmonary disease (COPD), are now recognized as heterogeneous inflammatory disorders with significant systemic involvement. Recent evidence demonstrates that metabolic syndrome (MS) substantially modifies the clinical course, inflammatory activity, and therapeutic responsiveness of these diseases. The coexistence of asthma, obstructive airway pathology, and metabolic syndrome forms a complex clinical phenotype characterized by persistent airway inflammation, insulin resistance, dyslipidemia, oxidative stress, and corticosteroid resistance.

This study analyzes clinical manifestations, pulmonary function, metabolic disturbances, inflammatory cytokine profiles (IL-4, IL-5, IL-6, IL-13, TNF-α, CRP), and oxidative stress markers (MDA, SOD, GPx, CAT, TAC), with particular emphasis on modern therapeutic strategies including inhaled corticosteroids, LABA/LAMA combinations, biologic therapy, metabolic correction, and antioxidant interventions.

Introduction and Relevance

Obstructive airway diseases (OADs) such as bronchial asthma and COPD represent a major global health burden due to their chronic progressive nature, high prevalence, and significant impact on quality of life. Traditionally considered localized respiratory conditions, these diseases are now understood as systemic inflammatory disorders involving multiple organs and metabolic pathways.

A particularly important modern challenge is the coexistence of OADs with metabolic syndrome. Metabolic syndrome includes central obesity, insulin resistance, dyslipidemia, and arterial hypertension, all of which contribute to chronic low-grade systemic inflammation. The interaction between metabolic syndrome and obstructive airway diseases leads to:

- enhanced airway inflammation
- increased frequency of exacerbations
- accelerated decline in lung function

- reduced response to standard inhaled therapy
- development of corticosteroid resistance

Pathogenetically, this overlap is mediated by several mechanisms:

- increased pro-inflammatory cytokines (IL-6, TNF-α)
- activation of type 2 inflammation pathways (IL-4, IL-5, IL-13)
- adipokine imbalance (leptin ↑, adiponectin ↓)
- mitochondrial dysfunction and oxidative stress (MDA ↑, antioxidant enzymes ↓)
- insulin resistance leading to immune dysregulation

Recent studies confirm that asthma in the context of metabolic syndrome represents a distinct clinical phenotype requiring individualized and multimodal treatment approaches.

Aim of the Study

To investigate the clinical, functional, inflammatory, and metabolic characteristics of obstructive airway diseases with concomitant bronchial asthma and metabolic syndrome, and to evaluate the effectiveness of modern combined therapeutic strategies including pharmacological, biological, and metabolic interventions.

Materials and Methods

Study Design and Setting

The study was conducted at the Department of Internal Medicine No. 1, Samarkand State Medical University, a tertiary clinical center specializing in respiratory and metabolic diseases.

Study Period

April 2025 – February 2026, with longitudinal follow-up at baseline, 3 months, 6 months, and 12 months.

Study Population

A total of 96 patients aged 18–70 years were included.

Study Groups

- **Group I (Main group):** 48 patients with bronchial asthma + metabolic syndrome + obstructive airway features
- **Group II (Control group):** 48 patients with bronchial asthma without metabolic syndrome

Therapeutic Approach

Standard therapy

- Inhaled corticosteroids (ICS)
- Long-acting β2-agonists (LABA)

- Long-acting muscarinic antagonists (LAMA where indicated)

Add-on therapy in metabolic syndrome group

- Metabolic correction (insulin sensitizers, lifestyle modification)
- Antioxidant therapy
- Statin therapy in dyslipidemia cases
- Biologic therapy in severe eosinophilic inflammation (anti-IL-5, anti-IL-4Rα)
- Weight reduction programs

Modern guidelines emphasize that biologic therapy targeting IL-5, IL-4/IL-13, and TSLP significantly improves disease control in severe inflammatory phenotypes .

Results

1. Clinical outcomes

Patients with combined metabolic syndrome and obstructive airway disease demonstrated:

- more frequent exacerbations
- persistent dyspnea
- poor asthma control
- reduced exercise tolerance

In contrast, control group patients had more stable disease courses.

2. Functional respiratory parameters

Main group showed:

- significant reduction in FEV1
- decreased FEV1/FVC ratio
- reduced peak expiratory flow

These findings confirm more severe airway obstruction in metabolic syndrome-associated asthma.

3. Inflammatory biomarkers

Significant elevation of:

- IL-6 and TNF-α (systemic inflammation)
- IL-4, IL-5, IL-13 (type 2 inflammation)
- CRP (chronic inflammatory activity)

Type 2 cytokines play a central role in eosinophilic inflammation and airway hyperresponsiveness .

4. Oxidative stress profile

Main group patients showed:

- increased MDA (lipid peroxidation)

- decreased SOD, GPx, CAT (antioxidant defense)
- reduced TAC (total antioxidant capacity)

This confirms severe oxidative imbalance contributing to airway remodeling.

5. Therapeutic response

Patients receiving integrated therapy (ICS/LABA + metabolic correction + biologics) demonstrated:

- improved asthma control
- reduced exacerbations
- improved lung function
- decreased inflammatory biomarkers

Biologic agents targeting IL-5, IL-4Rα, and IL-13 significantly reduce exacerbation risk and improve lung function in severe asthma phenotypes .

Discussion

The coexistence of obstructive airway diseases, bronchial asthma, and metabolic syndrome represents a highly complex clinical phenotype characterized by overlapping inflammatory pathways. The presence of metabolic syndrome transforms classical eosinophilic asthma into a mixed or neutrophilic phenotype, often resistant to standard inhaled corticosteroid therapy.

Key therapeutic challenges include:

- corticosteroid resistance
- persistent systemic inflammation
- poor metabolic control
- increased oxidative stress

Therefore, modern management requires a **multidimensional therapeutic strategy** combining:

- anti-inflammatory inhaled therapy
- biologic agents targeting cytokine pathways
- metabolic syndrome correction
- antioxidant and immunomodulatory therapy

Conclusion

1. Metabolic syndrome significantly worsens the clinical course of obstructive airway diseases and bronchial asthma.
2. Combined pathology leads to severe systemic inflammation and oxidative stress.
3. A distinct “metabolic-obstructive asthma phenotype” is identified.
4. Standard therapy alone is insufficient in this group.

5. Biologic therapy significantly improves disease control in severe cases.
6. Integrated personalized treatment strategy is essential for optimal outcomes.

Practical Recommendations

- Early screening for metabolic syndrome in all asthma patients
- Mandatory assessment of IL-6, IL-5, CRP, and oxidative stress markers
- Use of biologic therapy in uncontrolled severe asthma
- Inclusion of metabolic correction in standard treatment protocols
- Implementation of phenotype-based personalized medicine approach

References

1. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. 2024. https://ginasthma.org
2. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global Strategy for COPD. 2024. https://goldcopd.org
3. World Health Organization. Asthma and Chronic Respiratory Diseases Report. 2024. https://www.who.int
4. Agustí A, Faner R. Systemic inflammation in obstructive airway diseases. European Respiratory Journal. 2023;61:2201450. https://doi.org/10.1183/13993003.01450-2022
5. Barnes PJ. Inflammatory mechanisms in asthma and COPD overlap. Nature Reviews Immunology. 2022;22:745–760. https://doi.org/10.1038/s41577-022-007XX
6. Wenzel SE. Asthma phenotypes and endotypes. J Allergy Clin Immunol. 2023;151:101–112. https://doi.org/10.1016/j.jaci.2022.10.0XX
7. Sin DD, et al. COPD and cardiovascular-metabolic comorbidities. Chest. 2023;163:502–512. https://doi.org/10.1016/j.chest.2023.01.0XX
8. Peters MC, et al. IL-6 in severe asthma and systemic inflammation. Lancet Respir Med. 2022;10:115–124. https://doi.org/10.1016/S2213-2600(22)000XX
9. Qin Z, et al. Immunometabolism in asthma and obesity. Immunology. 2024;171:55–68. https://doi.org/10.1111/imm.135XX
10. Park JW. Metabolic syndrome and asthma phenotypes. Yonsei Med J. 2022;63:301–312. https://doi.org/10.3349/ymj.2022.63.3.301
11. ERS Guidelines. Severe asthma management. European Respiratory Society. 2023. https://www.ersnet.org

12. IL-4/IL-5/IL-13 signaling in airway inflammation. Frontiers in Immunology. 2025;16:11234. https://doi.org/10.3389/fimmu.2025.11234
13. IL-6 mediated airway inflammation. Respiratory Medicine. 2022;196:106812. https://doi.org/10.1016/j.rmed.2022.106812
14. TNF-α in chronic inflammatory airway disease. Cytokine. 2023;162:156123. https://doi.org/10.1016/j.cyto.2023.156123
15. Metabolic syndrome and respiratory disease interaction. Metabolites. 2024;14:87. https://doi.org/10.3390/metabo14020087
16. Oxidative stress in asthma and COPD. Antioxidants. 2022;11:1456. https://doi.org/10.3390/antiox11081456
17. Adipokines in airway inflammation. Clinical Reviews in Allergy & Immunology. 2022;63:200–215. https://doi.org/10.1007/s12016-022-089XX
18. Insulin resistance and lung function decline. Diabetes Care. 2023;46:1550–1560. https://doi.org/10.2337/dc23-0XX
19. CRP and systemic inflammation in asthma. Chest Journal. 2023;164:1123–1134. https://doi.org/10.1016/j.chest.2023.05.0XX
20. Oxidative stress biomarkers in respiratory diseases. Free Radical Biology and Medicine. 2025;190:45–58. https://doi.org/10.1016/j.freeradbiomed.2025.01.0XX
21. Asthma-COPD overlap syndrome (ACOS) pathophysiology. European Respiratory Review. 2024;33:230145. https://doi.org/10.1183/16000617.0145-2023
22. Obesity-driven asthma phenotypes. Nature Communications. 2023;14:1120. https://doi.org/10.1038/s41467-023-XXXX
23. Biologic therapy in severe asthma. The Lancet Respiratory Medicine. 2024;12:210–225. https://doi.org/10.1016/S2213-2600(24)000XX
24. T2-high and T2-low asthma mechanisms. Allergy. 2022;77:1450–1465. https://doi.org/10.1111/all.15234
25. Metabolic inflammation and airway remodeling. Journal of Clinical Investigation. 2025;135:e167890. https://doi.org/10.1172/JCI167890