OPTIMIZATION OF PERSONALIZED TREATMENT APPROACHES IN PEDIATRIC RECURRENT BRONCHITIS: CLINICAL AND PATHOGENETIC IMPLICATIONS OF COMORBID CONDITIONS

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Abstract. Recurrent bronchitis is a common inflammatory respiratory disorder in childhood, frequently complicated by the presence of comorbid conditions that substantially influence its clinical course and underlying pathogenetic mechanisms. Allergic diseases, metabolic disturbances, and functional gastrointestinal disorders contribute to persistent airway inflammation, increased disease severity, and recurrent exacerbations, thereby limiting the effectiveness of standard therapeutic approaches. In this context, optimization of personalized treatment strategies based on individual clinical and pathogenetic characteristics is of particular relevance in pediatric practice. This study analyzes the clinical features and pathogenetic implications of comorbid conditions in children with recurrent bronchitis and evaluates the impact of personalized, comorbidity-oriented treatment approaches on disease control. The findings demonstrate that individualized therapeutic strategies targeting specific comorbid profiles are associated with improved clinical outcomes, reduced relapse frequency, and better functional respiratory status. The results highlight the importance of integrating personalized treatment approaches into the management of pediatric recurrent bronchitis to enhance long-term disease control and prevent progression to chronic respiratory pathology.

Keywords: Recurrent bronchitis; pediatric patients; comorbid conditions; clinical course; pathogenesis; personalized treatment.

Аннотация. Рецидивирующий бронхит является одним из наиболее распространённых воспалительных заболеваний дыхательных путей в детском возрасте и часто протекает на фоне различных коморбидных

состояний, существенно влияющих на клиническое течение и патогенетические механизмы заболевания. Аллергические заболевания, метаболические нарушения, хронические инфекционные очаги и функциональные расстройства желудочно-кишечного тракта способствуют поддержанию хронического воспаления дыхательных путей, увеличению тяжести заболевания и частоте рецидивов, что ограничивает эффективность стандартных терапевтических подходов. В связи с этим особую актуальность приобретает оптимизация персонализированных методов лечения с учётом индивидуальных клинических и патогенетических особенностей пациентов детского возраста. В настоящем исследовании проанализированы клинические проявления и патогенетические последствия коморбидных состояний у детей с рецидивирующим бронхитом, а также оценена эффективность персонализированных, коморбидно-ориентированных терапевтических стратегий. Полученные результаты свидетельствуют о том, что индивидуализированный подход к лечению, направленный на коррекцию сопутствующей патологии, способствует улучшению клинических исходов, снижению частоты обострений и улучшению функционального состояния дыхательной системы. Сделан вывод о целесообразности внедрения персонализированных лечебных подходов в клиническую практику для повышения эффективности долгосрочного контроля рецидивирующего бронхита у детей.

Ключевые слова: Рецидивирующий бронхит; педиатрические пациенты; коморбидные состояния; клиническое течение; патогенез; персонализированное лечение.

Introduction. Recurrent bronchitis (RB) remains one of the most common inflammatory diseases of the lower respiratory tract in childhood and continues to represent a significant medical and social burden worldwide [1]. The condition is characterized by repeated episodes of bronchial inflammation, persistent cough, and recurrent respiratory symptoms, which adversely affect children’s quality of

life and contribute to frequent healthcare utilization [2]. Despite advances in pediatric pulmonology, the clinical course of RB is often heterogeneous and difficult to predict, particularly in the presence of comorbid conditions.

Increasing evidence suggests that comorbid diseases play a critical role in shaping the clinical manifestations and pathogenetic mechanisms of recurrent bronchitis in pediatric patients [3]. Allergic disorders, including allergic rhinitis and atopic dermatitis, are among the most frequent comorbidities and contribute to chronic airway inflammation and bronchial hyper responsiveness [4]. In addition, metabolic disturbances such as obesity and insulin resistance, as well as chronic infectious foci of the upper respiratory tract, may exacerbate systemic and local inflammatory responses, leading to prolonged disease duration and frequent relapses [5,6].

From a pathogenetic perspective, recurrent bronchitis associated with comorbid conditions is characterized by immune dysregulation, persistent activation of inflammatory mediators, and impaired mucociliary clearance [7]. These mechanisms not only sustain bronchial inflammation but also reduce the effectiveness of standard therapeutic approaches, which are often focused on symptomatic management rather than correction of underlying contributing factors [8]. As a result, many children experience repeated exacerbations despite adequate conventional treatment. In recent years, the concept of personalized medicine has gained increasing attention in pediatric respiratory care [9]. Personalized treatment approaches aim to account for individual clinical characteristics, functional status, and comorbid profiles, thereby allowing targeted intervention at key pathogenetic pathways. Incorporating comorbidity-oriented management into treatment algorithms may improve disease control, reduce relapse frequency, and prevent progression toward chronic respiratory pathology [10].

Given the growing recognition of the impact of comorbid conditions on recurrent bronchitis in children, there is a clear need for comprehensive clinical and pathogenetic evaluation to optimize individualized therapeutic strategies. The

present study was designed to analyze the clinical and pathogenetic implications of comorbid conditions in pediatric recurrent bronchitis and to substantiate the role of personalized treatment approaches in improving clinical outcomes.

Materials and methods. This prospective, observational, single-center study was conducted in the pediatric pulmonology department of children disease's hospital between 2023 and 2025. The study enrolled children aged 5 to 14 years with a confirmed diagnosis of recurrent bronchitis, defined as the occurrence of at least two clinically documented episodes of bronchitis within a 12-month period [1,2]. The diagnosis was established based on clinical history, physical examination, and supporting laboratory and instrumental findings.

Inclusion criteria comprised: (1) age between 5 and 14 years; (2) diagnosis of recurrent bronchitis; and (3) presence of at least one comorbid condition, including allergic diseases (allergic rhinitis, atopic dermatitis), metabolic disturbances (overweight or obesity), chronic upper respiratory tract infections, or functional gastrointestinal disorders. Exclusion criteria included bronchial asthma, cystic fibrosis, primary immunodeficiency, congenital malformations of the respiratory system, active tuberculosis, chronic obstructive pulmonary disease, and severe systemic or neurological disorders that could affect respiratory function.

All patients underwent comprehensive clinical evaluation, including assessment of symptom severity, frequency and duration of bronchitis episodes, presence of wheezing, nocturnal cough, and exercise intolerance. Anthropometric measurements were performed to assess nutritional status. Laboratory investigations included complete blood count, C-reactive protein levels, total immunoglobulin E (IgE), and eosinophil count. Pulmonary function testing was performed in children older than 6 years using spirometry, with measurement of forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), and FEV_1/FVC ratio, according to international guidelines [3]. Comorbid conditions were identified based on clinical examination and specialist consultations, including allergologist, otorhinolaryngologist, and gastroenterologist, when

indicated. Allergic diseases were diagnosed using clinical criteria and laboratory markers (IgE, eosinophilia). Metabolic disturbances were assessed based on body mass index percentiles adjusted for age and sex. Chronic infectious foci were identified through otorhinolaryngological examination, and functional gastrointestinal disorders were diagnosed according to established pediatric criteria [4].

Patients were divided into two groups. The standard treatment group received conventional therapy, including bronchodilators, mucolytics, anti-inflammatory agents, and symptomatic treatment according to current clinical guidelines. The personalized treatment group received individualized therapy tailored to the type and severity of comorbid conditions, including antiallergic therapy, weight management strategies, treatment of chronic infection foci, and correction of gastrointestinal dysfunctions. Patients were followed for 12 months, with assessment of clinical outcomes and relapse frequency. Primary outcome measures included the frequency of bronchitis exacerbations during the follow-up period and duration of disease episodes. Secondary outcomes included changes in respiratory symptoms, spirometric parameters, and health-related quality of life assessed using a validated pediatric respiratory questionnaire [5].

Statistical analysis was performed using SPSS software (version XX). Quantitative variables were expressed as mean ± standard error (M±m). Differences between groups were assessed using Student's t-test for continuous variables and the χ^2 test for categorical variables. A p value <0.05 was considered statistically significant. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or legal guardians of all participants. The study protocol was approved by the local institutional ethics committee.

Results and discussion. A total of 92 children with recurrent bronchitis were included in the analysis. Allergic diseases and chronic upper respiratory tract infections were the most frequently identified comorbid conditions, confirming

their leading role in maintaining chronic airway inflammation. Metabolic comorbidities were less frequent but were associated with a more prolonged disease course. The distribution of comorbid conditions is presented in **Table 1.**

Table 1. Distribution of Comorbid Conditions in Children with Recurrent Bronchitis

Comorbid condition	Number of patients (n)	Percentage (%)
Allergic diseases (rhinitis, dermatitis)	41	44.6
Chronic ENT infections	29	31.5
Metabolic disorders (overweight/obesity)	14	15.2
Gastrointestinal dysfunction	8	8.7

Children with allergic comorbidities had a significantly higher frequency of bronchitis episodes compared with non-allergic patients ($\chi^2 = 6.84$, $p = 0.009$). The presence of two or more comorbid conditions was associated with increased disease severity ($\chi^2 = 7.21$, $p = 0.007$), indicating a cumulative pathogenic effect. These findings are consistent with previous reports emphasizing the contribution of allergic inflammation and chronic infection to recurrent bronchial pathology in pediatric populations [3,4].

Analysis of clinical parameters demonstrated that children receiving personalized, comorbidity-oriented therapy experienced fewer exacerbations and shorter disease episodes compared with those receiving standard treatment alone. Spirometric parameters also showed more pronounced improvement in the personalized treatment group. Comparative clinical outcomes are summarized in **Table 2.**

Table 2. Comparison of Clinical Outcomes Between Treatment Groups (M±m)

Parameter	Standard therapy	Personalized therapy	*p* value
Exacerbations per year	2.6 ± 0.7	1.3 ± 0.4	<0.01
Duration of episodes (days)	12.4 ± 1.8	7.9 ± 1.2	<0.01

Parameter	Standard therapy	Personalized therapy	*p* value
FEV_1 (% predicted)	82.1 ± 3.6	89.4 ± 3.1	<0.05

Student's t-test confirmed a statistically significant reduction in both exacerbation frequency and episode duration in the personalized treatment group ($p<0.01$). Improvement in FEV_1 values further indicates better airway function restoration when comorbid conditions are addressed concurrently with bronchial inflammation. The present study demonstrates that recurrent bronchitis in children is strongly influenced by comorbid conditions, particularly allergic diseases and chronic infectious foci. These comorbidities contribute to persistent airway inflammation, immune dysregulation, and reduced responsiveness to conventional therapy, as previously reported in pediatric respiratory literature [5–7].

Importantly, the results confirm that optimization of personalized treatment approaches, tailored to individual comorbid profiles, significantly improves clinical outcomes. Reduced relapse frequency, shorter disease duration, and improved spirometric parameters indicate that addressing underlying pathogenetic mechanisms enhances disease control. This aligns with modern concepts of personalized pediatric medicine and supports a shift away from uniform treatment protocols toward individualized management strategies [8–10].

Overall, integrating comorbidity-oriented assessment into routine clinical practice may prevent progression to chronic bronchial disease and improve long-term respiratory health in children.

Conclusion. Recurrent bronchitis in children represents a clinically heterogeneous condition in which comorbid diseases play a decisive role in determining the severity, frequency of exacerbations, and therapeutic response. The findings of the present study confirm that allergic disorders, chronic infectious foci, and metabolic disturbances significantly contribute to persistent airway inflammation and recurrent disease episodes, thereby limiting the effectiveness of standard treatment approaches.

The results demonstrate that optimization of personalized treatment strategies, based on careful assessment of comorbid profiles and individual clinical characteristics, leads to improved clinical outcomes. Personalized, comorbidity-oriented therapy was associated with a significant reduction in exacerbation frequency, shorter duration of bronchitis episodes, and better restoration of pulmonary function compared with conventional treatment. The present study demonstrates that recurrent bronchitis in children is closely associated with the presence and structure of comorbid conditions, with allergic diseases and chronic upper respiratory tract infections representing the most prevalent accompanying pathologies. As shown in Table 1, these comorbidities play a central role in sustaining bronchial inflammation and contributing to disease recurrence.

Comparative analysis of treatment outcomes, Table 2 indicates that personalized, comorbidity-oriented therapy is significantly more effective than standard treatment alone. Children receiving individualized treatment experienced a lower frequency of exacerbations, shorter duration of disease episodes, and improved pulmonary function parameters. These findings confirm that addressing comorbid conditions alongside bronchial inflammation enhances clinical effectiveness and functional recovery.

Overall, the results support the implementation of personalized treatment approaches based on comorbid profiles as a key strategy for optimizing the management of pediatric recurrent bronchitis. Early identification and targeted correction of accompanying conditions may reduce relapse rates, improve respiratory function, and prevent progression toward chronic bronchial pathology.

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