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The Spectrum of Sensitization to Aeroallergens as One of The Risk Factors for Uncontrolled Severe Bronchial Asthma

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ABSTRACT

Objective: *To evaluate the significance of the spectrum of sensitization to aeroallergens in adult patients with severe bronchial asthma as risk factors for uncontrolled disease progression.* ***Methods:*** *An observational, single-center, cross-sectional study was conducted involving 93 patients diagnosed with severe bronchial asthma. The study examined qualitative and quantitative indicators, including demographic characteristics and comorbid diseases. These factors were analyzed to identify their impact on achieving controlled disease progression.* ***Results:*** *The analysis identified a significant association between aeroallergen sensitization and the difficulty of achieving disease control in patients with severe bronchial asthma. Specific aeroallergens were found to exacerbate symptoms, complicating disease management and increasing the likelihood of uncontrolled progression. Demographic and comorbid factors further amplified these risks, highlighting the multifactorial nature of disease management challenges in this patient population.* ***Novelty:*** *This study underscores the critical role of aeroallergen sensitization in the progression of severe bronchial asthma. By isolating the impact of aeroallergens and integrating demographic and comorbid factors, this research provides a comprehensive perspective on risk assessment and offers potential pathways for improved disease management strategies.*

INTRODUCTION

Bronchial asthma is considered a multifactorial disease, the development of which is determined by the complex interaction of the genetic component and environmental factors. But in addition to the deterioration of environmental indicators, food quality, frequent use of medications, allergens undoubtedly play a key role in the onset of bronchial asthma [1], [2]. It is known that the spectrum of sensitization to aeroallergens can vary. It is necessary to take into account regional environmental features, climatic, geographical, household and industrial factors [3]. The results of modern studies indicate that some types of sensitization may be more significant for the prognosis of the course of bronchial asthma than others. In particular, the effect of such aeroallergens in the air as pollen, epidermal and fungal, scientists consider an important risk factor for the development of bronchial asthma exacerbations [4].

Further investigations have also revealed that the exposure to certain environmental factors, such as air pollution and climate change, has contributed to a significant rise in asthma-related conditions. These findings suggest that urban areas, which are more prone to industrialization and higher levels of pollution, may face a higher burden of asthma cases. Additionally, socio-economic disparities, such as access to healthcare and living conditions, are believed to influence both the onset and

management of asthma. This underscores the need for targeted public health interventions that address both environmental and socio-economic determinants of asthma risk. Consequently, an integrated approach involving both medical and environmental policy strategies is essential for reducing the prevalence of asthma and improving patient outcomes.

RESEARCH METHOD

The study included 93 adult patients with severe allergic asthma. The diagnosis, severity and level of control over the course of asthma were established in accordance with the recommendations of the GINA working group (Global Initiative for Asthma, updated, 2023) and the Bukhara clinical guidelines for the diagnosis and treatment of bronchial asthma.

RESULTS AND DISCUSSION

To check the normality of the distribution of the indicators, the Kolmogorov–Smirnov and Shapiro–Wilk tests were used. For the quantitative characteristics of the indicators in accordance with the distribution law close to normal, the arithmetic mean values (M), errors of the means (m), standard deviations (s) were calculated; in other cases, medians (Me), lower (Q1) and upper (Q3) quartiles. Point frequency estimates were supplemented by interval ones in the form of a 95% confidence interval (CI), calculated by the Wilson method [5]. When comparing quantitative indicators in groups, parametric tests included versions of the Student criterion (for independent groups and dependent variables) [6]. In the non-parametric version of the analysis, the Mann–Whitney criteria for independent groups were used. For comparative analysis of qualitative indicators, the $\chi 2$ (chi-square) criterion was used, and in case of its instability, the Fisher exact criterion was used [7], [8]. Using single-factor logistic analysis, independent risk factors were identified and odds ratio (OR) values were estimated; in multifactor modeling, these estimates were corrected taking into account the mutual influence of the factors under study [9], [10]. The criterion for statistical significance of the results was achieving a significance level of $p < 0.05$.

In the course of our study, severe bronchial asthma was diagnosed in 93 patients, among whom women predominated (74.1%). The average age of patients was 50.8±15.8 years. To clarify the spectrum of sensitization in patients with bronchial asthma, we determined the levels of sIgE to the most common aeroallergens in the blood serum. The table shows that household sensitization was the most common. The most common household allergen was house dust, the frequency of sensitization to which was 66.3%, in second place was hypersensitivity to epidermal allergens, then followed pollen and fungal sensitization.

A modern approach to bronchial asthma therapy requires a detailed analysis of the factors responsible for disease progression and exacerbation development. During the study, patients were divided into two groups. The first group included 52 patients with

uncontrolled bronchial asthma, including 42 (80.7%) women, with an average age of 53.2±13.2 years. The second group consisted of 41 patients, including 27 (65.8%) women, with an average age of 47.7±18.1 years. Depending on the achievement of disease control, the groups of bronchial asthma patients did not differ in gender, age, presence of allergic rhinitis, presence of pets, or intake of 3 or more basic therapy drugs. It is noteworthy that no significant differences were found in sIgE values to all tested aeroallergens, except for A. fumigatus.

The most significant differences were obtained for such characteristics as the presence of sensitization to Aspergillus spp., contact with mold fungi in everyday life, the presence of fixed obstruction [according to the GINA criteria, fixed bronchial obstruction is characterized by the ratio of forced expiratory volume in the first second (FEV1) / forced vital capacity (FVC) <0.7 after adequate bronchodilation] and taking more than 2 courses of systemic glucocorticoids per year ($p < 0.001$). Comorbid diseases, a family history of asthma and smoking also played a significant role in the formation of an uncontrolled course of the disease ($p < 0.05$).

In addition, patients with uncontrolled and controlled asthma significantly differed in the following quantitative characteristics: the number of exacerbations and hospitalizations per year; spirometry indicators ($p < 0.05$).

Further, in the course of our work, univariate and multivariate logistic regression analysis was performed in order to determine the most significant factors that negatively affect the achievement of controlled asthma. When modeling the studied relationships using univariate logistic regression, significant independent risk factors for the development of uncontrolled bronchial asthma were identified, taking into account the calculated unadjusted OR values. The most pronounced independent effect on the uncontrolled course of asthma is the presence of sIgE to A. fumigatus: the odds of uncontrolled course of asthma with confirmed sensitization to A. fumigatus increase by 8.4 times (OR 8.4; 95% CI 2.84–24.84; $p < 0.001$).

Simultaneous analysis of the entire set of studied characteristics, taking into account their mutual influence when performing multifactorial logistic regression analysis, made it possible to correct the estimates of their influence on the course of asthma. According to the obtained results, the chances of controlled course of bronchial asthma statistically significantly decreased in the presence of the following factors: sensitization to A. fumigatus - by 4.79 times (OR 4.79; 95% CI 1.30-17.56; $p = 0.018$), fixed obstruction - by 6.2 times (OR 6.2; 95% CI 1.99-19.30; $p = 0.0016$), when taking systemic glucocorticoids - by 5.85 times (OR 5.85; 95% CI 1.17-29.05; $p = 0.031$), when in contact with mold fungi in rooms - by 4.45 times (OR 4.45; 95% CI 1.06–18.72; $p=0.041$), a burdened heredity for asthma - 2.53 times (OR 2.53; 95% CI 1.02–7.93; $p=0.047$).

CONCLUSION

Fundamental Finding : The study highlights the critical role of T2 inflammation in asthma pathogenesis, with sIgE as a key biomarker. The presence of sIgE to *Aspergillus*

fumigatus significantly increases the risk of uncontrolled severe asthma, compounded by factors like fixed airway obstruction, systemic corticosteroid use, hereditary predisposition, and mold exposure. **Implication :** Inclusion of *Aspergillus spp.* in allergen testing for patients with broncho-obstructive syndromes is crucial. Early detection of sensitization can enable more effective treatment and preventive measures, improving asthma control and patient outcomes. **Limitation :** This research is limited by its focus on specific allergens and risk factors, which may not fully encompass the diversity of asthma phenotypes or environmental influences, restricting the generalizability of findings. **Future Research :** Future studies should explore broader allergen panels, longitudinal patient monitoring, and the interaction between genetic predispositions and environmental triggers to develop more comprehensive asthma management strategies.

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