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T.Ye. Shumna, O.S. Fedosieieva, T.P. Zinchenko
Zaporizhzhia State Medical University, Zaporizhzhia

ASSESSMENT OF RESPIRATORY SYSTEM'S FUNCTIONAL STATE IN CHILDREN WITH BRONCHIAL ASTHMA AND ALLERGIC RHINITIS

e-mail: tshumnaya72@gmail.com

The study of the external respiration function by the method of spirometry was performed in 138 children from 7 to 17 years of age, among them, observation group I included 78 children with bronchial asthma; group II included 40 children with allergic rhinitis; group III included 20 virtually healthy children. It was established that in children with bronchial asthma, the obstructive pulmonary ventilation function was impaired in 67.95% of cases, the restrictive one - in 16.67% and the mixed one- in 2.56% of patients. In children with allergic rhinitis, the obstructive ventilation disorders in 32.5% of cases were caused by the combined orthodontic pathology, namely, the distal occlusion and in 12.5% - by chronic allergic inflammation of the respiratory tract without tooth-jaw anomalies, which required an individual approach to the choice of treatment and prevention. The functional state indices of the respiratory system during spirometry should be taken into account both for determining the type of ventilation disorders in children with bronchial asthma and for differential diagnostics of chronic allergic inflammation of the respiratory tract and associated orthodontic pathology in children with allergic rhinitis.

Key words: bronchial asthma, allergic rhinitis, children, spirometry.

The work is a fragment of the scientific project "Optimization of differential diagnostics and treatment of allergic and other diseases in children of different ages", state registration No. 0118U004254.

At present, allergic diseases unceasingly continue to spread throughout the world with the incidence of bronchial asthma in the population ranging from 1% to 18% and allergic rhinitis – from 10% to 40%. [13] According to the modern concept of "single chronic allergic respiratory syndrome", allergic rhinitis and bronchial asthma have common triggers and pathogenetic mechanisms for the development of an immediate-type allergic reaction [7]. Although there is no "gold standard" for diagnostics of bronchial asthma (BA), the diagnostics criteria for this disease are the presence of both respiratory symptoms and the definition of expiratory disorders according to spirometry data: the decrease of the forced expiration volume indices in the first second (FEV_1) and the ratio of the forced expiration volume in the first second to the function of vital capacity of the lungs (FEV1/VC). [6] At the same time, the diagnostics of allergic rhinitis is based on clinical symptoms such as sneezing, itching, nasal congestion, discharge and loss of sensory sensitivity that deteriorate the quality of life in these patients even worse than in patients with mild or even with moderate severe bronchial asthma [3]. Impairment of the nasal breath also affects other functions of the organism, in particular the respiratory system, contributing to the development of external respiration dysfunction - restriction of chest excursion when the breathing becomes frequent and superficial, which results in pulmonary ventilation decreasing. Also, in an allergic rhinitis, the child constantly breathes through its open mouth, and the associated tension of the face muscles and the change in the configuration and growth of the face bones, head, upper and lower jaws are one of the leading etiological factors in the formation of distal occlusion in children and reduction of lungs life volume and impaired breathing, due to mechanical obstruction for normal breathing [11]. Today, in the field of practical medicine, the study of nasal breathing function (rhinopneumometry) has not been widely used, but there are works showing the diagnostics value of the study on the respiratory system's functional state in children with allergic rhinitis or with orthodontic pathology [1]. However, the nature of ventilatory disorders in children, both in case of chronic allergic inflammation and in case of orthodontic pathology, has not been completely studied. All this determines the relevance of the chosen research subject.

The purpose of the study was assessment of the lungs' ventilation function and performing the comparative analysis of the external respiration parameters in children with bronchial asthma and allergic rhinitis.

Materials and methods. In total 138 children aged 7 to 17 years old (mean age 13.5±2.84, namely 50 girls (36.23%) and 88 (63.77%) boys, were examined. Among them, group I consisted of 78 children with bronchial asthma (27 girls (34.62%) and 51 boys (65.38%); group II – 40 children with allergic rhinitis (14 girls (35%) and 26 boys (65%); group III (control) – 20 virtually healthy children (9 girls (45%) and 11 boys (55%). Although there were more boys than girls, however, the ratio of boys and girls in each group, when compared, did not have statistically significant differences, $p>0.05$. The function of external respiration was studied by spirometry method using a computer complex with an adapted software for the study of external respiration function "PULMOREM" TU U 33.1-02066769-005-2002 (Kharkiv) with automatic analysis of indices. The maneuver of forced expiration was performed three times, after which

the types of ventilation disorders were determined according to the main indices that characterized the function of external respiration: static lungs volume – vital capacity of the lungs (VC) and dynamic lungs volumes - forced vital capacity of the lungs (FVC), the forced expiration volume per one second (FEV1) and the ratio of FEV1/FVC%). Also, the parameters such as the maximal expiratory flow at the level of 25%, 50% and 75% of FVC (MEF25, MEF50 and MEF75) were analyzed. In order to diagnose the hidden bronchospasm, the children were provided with a broncholitic test with inhalation of 200 µg or 400 µg (depending on the age) of salbutamol, which was considered to be positive if the gain of FEV1 occurred to be equal to or exceeded 12% (or>200 ml). The statistical data processing was performed by means of commonly used methods of variation statistics using the licensed software package Statistica for Windows 6.1.RU, serial number AXXR712D833214SAN5. The non-parametric statistical methods were used: the medians and interquartile intervals were calculated, and the two independent groups were compared according to the Mann-Whitney criterion, the criterion $\chi 2$, and "2×2 Table". At $p<0.05$, the differences were considered statistically significant.

Results of the study and their discussion. In the result of the spirometric study, it was found that the medians and interquartile intervals of the most external respiration function indices in children, both with bronchial asthma and allergic rhinitis, were significantly different from those of healthy children and between each other (table1).

Table 1

Indices of the external respiration function in children (Me (Q25–Q75))

Groups	I	II	III
VC (%)	65.91 (56.83–79.19) ^{*II,*III}	94.00 (81.05–100.48) ^{*I,*III}	107.00 (100.48–111.00) ^{*I,*II}
FVC(%)	75.13 (63.73–87.05)^{*II,*III}	93.00 (75.79–101.5)^{*I}	99.05 (93.1–100.25)^{*I}
FEV_1(%)	73.97 (62.57–81.84)^{*II,*III}	92.5 (70.52–104.3)^{*I,*III}	105.15 (100.25–108.15)^{*I,*II}
FEV_1/ FVC(%)	93.84 (81.12–100)^{*II,*III}	98.32 (85.86–106.5) ^{*I,*III}	107.20 (102.95–110.65)^{*I,*II}
MEF_{25}(%)	75.89 (64.56–90.54)^{*II,*III}	95 (68.54–102.65) ^{*I,*III}	101.6 (94.9–117.5)^{*I,*II}
MEF_{50}(%)	82.45 (69.8–103.85)^{*III}	93.5 (70.88–105.05)	96.6 (77.75–102.7)^{*I}
MEF_{75}(%)	82.01 56.5–114.02)^{*II,*III}	99.0 (64.99–122.94)^{*I}	95.8 (86.4–109.5)^{*I}

Note: $^{*I, II, III}$ - reliability of the difference between the groups of children ($p<0.05$).

So, certainly, the highest results of the static index of VC and such dynamic indices as FEV1, FEV1/FVC, MEF 25 were registered in healthy children, and the lowest – in children with bronchial asthma. However, contrary to the anticipated data, in children with allergic rhinitis, although the medians of these data were significantly higher than the results of children with bronchial asthma, but did not reach the values of the healthy ones. The group of children with bronchial asthma had significantly lower FVC indicators and maximal expiratory flow at the level of 75 % or 50 % of FVC volume remaining in the lungs: MEF75 and MEF50, which was reflected by the resistance of respiratory tracts at a level of 75% of FVC of brochi with a diameter less than 3 mm, that is, small bronchi, and 50 % of bronchi FVC of medium caliber. Consequently, there was a uniform decrease in all indices of MEF 25 % – 75 % only in children with bronchial asthma, indicating a total (generalized) type of bronchial obstruction.

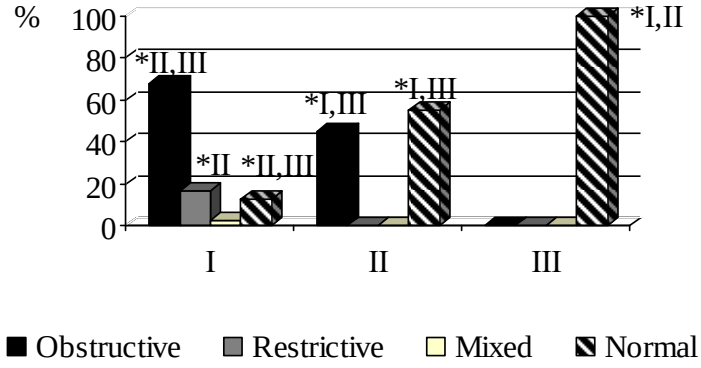

Fig. 1. Characteristics of the types of ventilation function of the lungs in children.

The generalized results of the study of volumetric and high-flow indicators of the function of external respiration and types of ventilatory disorders of the lungs in children are presented in the fig. 1.

It should be immediately noted that all healthy children (group III) had no disorders of the lungs ventilation function. However, in children of group I with bronchial asthma, the lungs ventilation function was impaired in 87.18% (68/78) and normal - only in

12.82 % (10/78) cases, and in children, in which the changes in the parameters of external respiration function indices were not found at once, the pharmacological test was performed with a short-acting beta-agonist, and, only in the absence of hidden bronchospasm, the ventilation function of the lungs was considered as normal one.

In children with allergic rhinitis (observation group II), the ventilation disorders were registered in 45% (18/40) patients, and in 55% (22/40) cases the function of external respiration was normal. At the same time, the obstructive ventilation disorders were registered in 67.95 % (53/78) of children with bronchial asthma versus 45 % (18/40) in children with allergic rhinitis ($\chi2 = 12.13$, $p = .0005$ – between the comparison groups I and II; $\chi2 = 31.14$, $p = .0000$ – between groups I and III, $\chi2 = 12.86$, $p = .0003$ – between groups II and III). The restrictive type of ventilation disorders was found only in 16.67 % (13/78) of children with bronchial asthma ($\chi2 = 7.49$, $p = .0062$ – between groups I and II and $\chi2 = 4.49$, $p = .0342$ – between children groups I and III). The mixed type of ventilation disorders was recorded in 2.56% (2/78) of the examined persons from group I. The restrictive and mixed types of external respiration functional disorders in children with bronchial asthma were caused by the presence of uncontrolled severe course of the disease. The obstructive changes of the spirograms indices of the examined children indicated that they had an obstacle to the air flow. In children with bronchial asthma, the obstructive ventilation disorders were caused by the hyper-reactivity of the bronchi, bronchial spasm, inflammation of the bronchial mucosa and edema. In order to determine the cause of ventilation disorders in children with allergic rhinitis, all children from group II were examined by a pediatric orthodontist for the diagnostics of tooth-jaw pathology, as an additional mechanical obstacle for normal breathing. Thus, it was found that 32.5% (13/40) of children with allergic rhinitis and obstructive type of ventilation disorders also had an orthodontic pathology in the form of distal occlusion, which became an additional mechanical obstacle when performing respiratory maneuver in these children during the spirometric study. These children subsequently received treatment from an allergist and pediatric orthodontist. Other 12.5 % (5/40) of children with allergic rhinitis and obstructive type of ventilation disorders, according to the modern concept, had chronic allergic inflammation of the respiratory tract, but without combination with orthodontic pathology, and also needed an individual approach in the appointment of therapeutic and preventive measures.

In the course of the discussion we compared our results with the data presented in the reference list and stated that when assessing the function of external respiration in children, it was necessary to consider both the main bronchopulmonary pathology and concomitant diseases, including those related to the dentofacial system. Thus, it was the spirometry used by Y.I. Feshchenko et al. for the implementation of the personified approach to confirmation of diagnosis with combined pathology of bronchial asthma and chronic obstructive pulmonary disease in adult patients with bronchopulmonary pathology with FEV/FVC ratio less than 70% [10].

However, in our study in children with bronchial asthma, the median rates of FEV / FVC ratio on the contrary exceeded 70% and amounted to 73.97 %, which indicates better functional state of the respiratory system in childhood without concomitant chronic obstructive pulmonary disease, when fixed wheezing and fixed hyperinflation are still not formed. At the same time, in children with acute bronchopulmonary diseases such as bronchitis, pneumonia, pleurisy, the mean VC was significantly reduced and was within the range of 59,94±18,71 % close to the median rates of the children with bronchial asthma examined by us (Me=65.91 (56.83 – 79.19). Significance of forced vital capacity of the lungs (FVC) and volume of forced exudation for 1 sec. with FEV1 (FEV1) in acute bronchopulmonary diseases (58.98±17.86 % and 57.32±19.51 %) were lower than the median in children with bronchial asthma in our study (75.13 % (63.73 – 87.05) and 73.97 % (62.57 – 81.84), however, out of 143 children with acute bronchopulmonary disease, restrictive disturbances were noted in 123 children, while the obstructive type in children with bronchial asthma was more commonly recorded (67.95 %) [5]. The study of the external respiration function, carried out in preschool children with wheezing syndrome, permitted to establish a diagnosis of bronchial asthma in 48.3% of examined patients [9].

The individual approach to the determination and assessment of reverse wheezing in children with bronchial asthma and more than 80% of the appropriate FEV1 (FEV1) values, regardless of the disease severity and the symptom control level, was scientifically substantiated by Rechkina O.O. et al. [8].
Comparative characteristics of the external respiration function in children with bronchial asthma and allergic rhinitis are presented in the work of Nevine El-Helaly et al. Thus, in children with bronchial asthma, the outgoing mean FVC rates were higher than in our study and amounted to 91.215 versus 75.13 in our study; FEV1 was 96.875 vs. 73.97. In patients with allergic rhinitis, the FVC and FEV1 data were identical to ours: 94.32 and 93 and 96.81 and 96.81, respectively [14].

However, in the work of Saranz R.J. et al., according to the results of the study, the spirometric parameters were reported in 22 % of children with allergic rhinitis, while in our study the ventilation

abnormalities were almost twice as frequent (45 %). [15]. The need for an objective study of the lungs' ventilation function in children with bronchial asthma is evidenced by the work of Alexander Moeller, who believes that the spirometric study should be periodically performed not only in children with bronchial asthma, but also in those with allergic rhinitis, especially if they have a risk of sleep-related breathing disorder [12].

As well as in our study in patients with distal occlusion, the reduction of the rates of external respiration was established in children with cutter disocclusion of dentition [4]. And the study of A.A. Adamchyk showed that in children with anomalies of bite, the mild and moderate bronchial asthma disorders, which were not accompanied by clinical manifestations, were recorded in 84 % of cases due to lower FEV_1, PIF, maximum bulk volume velocity at the 75%-level of forced lung capacity volume (MEF75) remaining in the lungs and Tiffeneau's index. At the same time, the decrease of VC in the range of 70-73 % was noted in 16 % of the examined patients with orthodontic pathology [1]. It was specified that in children with open bite and myofunctional disorders, the decrease in the parameters of external respiration was also recorded, including VC, which was decreased by 30.7 % compared to the control group without myofunctional violations [2].

The given data confirm the necessity of studying the function of external respiration during the examination of children both with bronchial asthma and with allergic rhinitis and orthodontic pathology.

Conclusions

1. The lungs' ventilation function in children with bronchial asthma in 67.95 % was disordered according to the obstructive type with a generalized decrease of the MEF indices by 25 % -75 %, the restrictive (16.67 %) and mixed types (2.56 %) were due to an uncontrolled severe course of the disease.

2. In children with allergic rhinitis, the obstructive ventilation disorders in 32.5 % of cases were caused by the combined orthodontic pathology, which complicated the implementation of respiratory maneuvers and in 12.5% by the presence of "single chronic allergic respiratory syndrome" without tooth-jaw anomalies, which required an individual approach in the prescription of medical and preventive measures.

3. The respiratory system's functional state indices during spirometry should be taken into account both for determining the type of ventilation disorders in children with bronchial asthma and for differential diagnostics of chronic allergic inflammation of the respiratory tract and concomitant orthodontic pathology in children with allergic rhinitis.

Prospects for further research. In the future, it is planned to give a comparative characteristics of indicators of external respiration in groups of children with different degrees of severity and controllability of bronchial asthma and in groups of patients only with allergic rhinitis, only with orthodontic pathology (with distal occlusion) and with a combination of allergic rhinitis and distal occlusion defining the most informative indicators for early diagnostics of ventilation disorders and a differentiated approach to prediction, prevention and treatment of these states in children.

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Реферати

ОЦІНКА ФУНКЦІОНАЛЬНОГО СТАНУ ДИХАЛЬНОЇ СИСТЕМИ У ДІТЕЙ З БРОНХІАЛЬНОЮ АСТМОЮ ТА АЛЕРГІЧНИМ РИНІТОМ

Шумна Т.Є., Федосєєва О. С., Зінченко Т. П.

Дослідження функції зовнішнього дихання методом спірометрії проводилося у 138 дітей від 7 до 17 років, з них, І групу спостереження склало 78 дітей з бронхіальною астмою; ІІ групу - 40 дітей з алергічним ринітом; ІІІ групу - 20 практично здорових дітей. Встановлено, що у дітей з бронхіальною астмою, вентиляційна функція легенів за обструктивного типу була порушена в 67,95% випадків, за рестриктивного - в 16,67% і за мішаного - у 2,56% пацієнтів. У дітей з алергічним ринітом обструктивні вентиляційні порушення в 32,5% випадків були обумовлені наявністю поєднаної ортодонтичної патології, а саме, дистальним прикусом і в 12,5% - наявністю хронічного алергійного запалення респіраторного тракту без зубо-щелепних аномалій, що вимагало індивідуального підходу у виборі лікування і профілактики. Спірометрію необхідно проводити всім дітям з клінічними симптомами респіраторної алергії, а показники функціонального стану дихальної системи необхідно враховувати як для визначення типу вентиляційних порушень у дітей з бронхіальною астмою, так і для диференціальної діагностики хронічного алергійного запалення респіраторного тракту і супутньої ортодонтичної патології у дітей з алергічним ринітом.

Ключові слова: бронхіальна астма, алергічний риніт, діти, спірометрія.

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ОЦЕНКА ФУНКЦИОНАЛЬНОГО СОСТОЯНИЯ ДЫХАТЕЛЬНОЙ СИСТЕМЫ У ДЕТЕЙ С БРОНХИАЛЬНОЙ АСТМОЙ И АЛЛЕРГИЧЕСКИМ РИНИТОМ

Шумная Т.Е., Федосеева Е. С., Зинченко Т. П.

Исследование функции внешнего дыхания методом спирометрии проводилось у 138 детей от 7 до 17 лет, из них, I группу наблюдения составило 78 детей с бронхиальной астмой; II группу – 40 детей с аллергическим ринитом; III группу – 20 практически здоровых детей. Установлено, что у детей с бронхиальной астмой, вентиляционная функция легких по обструктивному типу была нарушена в 67,95% случаев, по рестриктивному – в 16,67% и по смешаному – у 2,56% пациентов. У детей с аллергическим ринитом обструктивные вентиляционные нарушения в 32,5% случав были обусловлены наличием сочетанной ортодонтической патологией, а именно, дистальным прикусом и в 12,5% - наличием хронического аллергического воспаления респираторного тракта без зубо-челюстных аномалий, что требовало индивидуального подхода в выборе лечения и профилактики. Спирометрию необходимо проводить всем детям с клиническими симптомами респираторной аллергии, а показатели функционального состояния діхательной системы не обходимо учитывать как для определения типа вентиляционных нарушений у детей с бронхиальной астмой, так и для дифференциальной диагностики хронического аллергического воспаления респираторного тракта и сопутствующей ортодонтической патологии у детей с аллергическим ринитом.

Ключевые слова: бронхиальная астма, аллергический ринит, дети, спирометрия.

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A. G. Yareshko, M. V. Kulish
Ukrainian Medical Stomatological Academy, Poltava

GLUCOCORTICOIDS AS IMMUNOSTIMULATORS IN PATHOGENETIC THERAPY OF TUBERCULOSIS

e-mail: kaf.ftiziatrii.umsa@gmail.com

The immunostimulating effect of corticosteroids in the complex treatment of tuberculosis patients when they are administered in a double physiological dose, every other day, taking into account the circadian rhythm of the function of the hypothalamic-pituitary-adrenal axis was substantiated in the article. Whereas with daily administration, corticosteroids have shown an immunosuppressive effect. Peripheral blood B-lymphocytes are not sensitive to glucocorticosteroid drugs.

Key words: tuberculosis, pathogenetic therapy, glucocorticosteroids.

This work is a fragment of the research project "To study the effectiveness of pathogenetic agents in the complex treatment of destructive pulmonary tuberculosis with resistance to antibacterial drugs", state registration No. 0117U000304.

Tuberculosis (TB) disease is the result of the organism's immune response to infection with Mycobacterium tuberculosis (Mtb), but becoming infected with Mtb does not mean being sick. According to data of the World Health Organization, no more than 10% of infected people become ill during their lifetime, which indicates the high effectiveness of the human body's defense system. The main condition for tuberculosis development is immunodeficiency disease. The modern medical guideline for tuberculosis