

## CLINICAL AND FUNCTIONAL FEATURES OF CHRONIC LOWER RESPIRATORY DISEASES IN CHILDREN

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### ABSTRACT

The aim of the study was to study the clinical and functional features of the course of chronic bronchitis and bronchial asthma in children. The results of the study showed that in children with an aggravated allergic anamnesis, who had episodes of broncho-obstructive syndrome at an early age and had a history of perinatal damage of hypoxic genesis of the 1st degree of severity, there is a more severe course and prolonged relief of acute bronchial obstruction, in connection with this, such children needed a more comprehensive examination of the functional parameters of the respiratory system. Children with chronic bronchitis and bronchial asthma are characterized by changes in the functional parameters of the respiratory system, manifested by a high level of the acoustic component of the work of breathing in the full frequency range.

**KEYWORDS:** bronchial asthma, chronic bronchitis, clinic, computer bronchophonography, children.

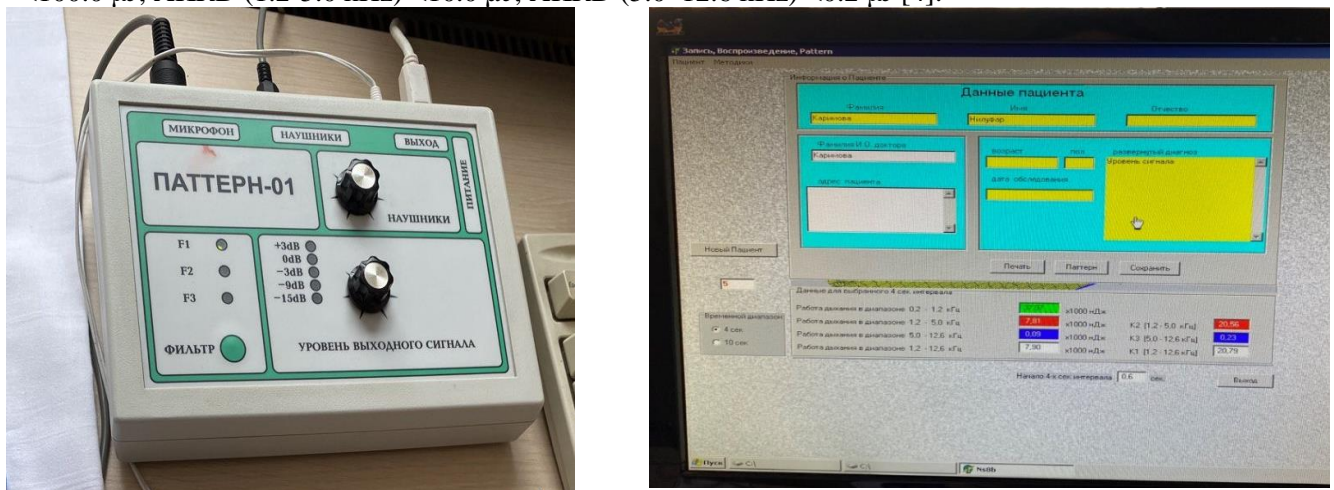
### INTRODUCTION

In recent years, there has been a trend towards an increase in the number of chronic respiratory diseases, both in adults and children [1], which often leads to a deterioration in the quality of life and disability of patients. Chronic bronchitis (CB) and bronchial asthma (BA) are the most common chronic lung diseases in children [2]. Despite the progress made in the diagnosis and treatment of these nosologies, which led to a decrease in the number of hospitalizations and deaths associated with it, CB and BA remain an urgent medical, social and economic problem in pediatrics [3]. Despite the painstaking work of doctors and researchers around the world in the study of CB and AD, the mechanisms of formation and course of these diseases, especially in childhood, are still not fully understood. Diagnosis of CB and AD at an early age is a difficult task, since clinical manifestations in this pathology are nonspecific and are observed in various diseases [2]. Determining the functional state of the respiratory organs in CB and BA is essential for the early diagnosis of pathological processes in the lungs, improving the treatment of patients, as well as an objective assessment of the condition of patients [3]. In recent decades, along with traditional methods of functional examination of the lungs, highly effective, non-invasive methods of acoustic diagnostics have begun to appear, based on the use of the latest achievements in acoustoelectronics and computer technologies [6]. Computer analysis of respiratory sounds, in contrast to subjective listening, makes it possible to objectify the duration and intensity of wheezing, which is especially important in early childhood [7]. One of the methods that are becoming increasingly common in pediatric practice is computerized bronchophonography (CBPG) [6]. CBPG registers specific acoustic phenomena that occur during breathing using a sensor that is highly sensitive in a wide frequency range, including frequencies that are not detected during auscultation, but are of great diagnostic value [5]. At the same time, this method makes it possible to control the dynamics of the disease and evaluate the effectiveness of therapy, for example, in BA and CB. CBPG is an effective, non-invasive method, easy to use, does not require forced breathing maneuvers, and can be used from the first days of life [3].

Purpose of the study. To study the clinical and functional features of the course of chronic bronchitis and bronchial asthma in children.

## MATERIALS AND METHODS

We examined 65 patients with atopic BA (group I) aged 3–16 years, and 45 patients with chronic bronchitis (group II). The control group consisted of 20 practically healthy children of the same age. The study was conducted in the Department of Pulmonology of the RSSPMC Pediatrics of the Ministry of Health of the Republic of Uzbekistan. The assessment of the function of external respiration (PFR) in all groups was carried out using computerized bronchophonography (CBPG) (automated bronchophonographic diagnostic device "PATTERN-01", MPEI, Russia) and a package of applied computer programs for visualization and processing of the results of the study - "Pattern 1x1000" [ 4]. (Fig. 1). The main parameter estimated using CBPG is the acoustic equivalent of the work of breathing (AKRD), the unit of measurement is microjoule - (mkJ). AKRD is defined in different frequency ranges: AKRD1 (0.2-1.2 kHz) - "zero" or basic range, AKRD2 (1.2-5.0 kHz) - mid-frequency range; AKRD3 (5.01–2.6 kHz) - high-frequency range [3.5]. When statistically processing the obtained data, confidence intervals (CI) with a probability of 95% and comparison with benchmarks were used. The following values were taken as reference indicators: AKRD (0.2–1.2 kHz) <100.0  $\mu$ J; AKRD (1.2-5.0 kHz) <10.0  $\mu$ J; AKRD (5.0–12.6 kHz) <0.2  $\mu$ J [4].

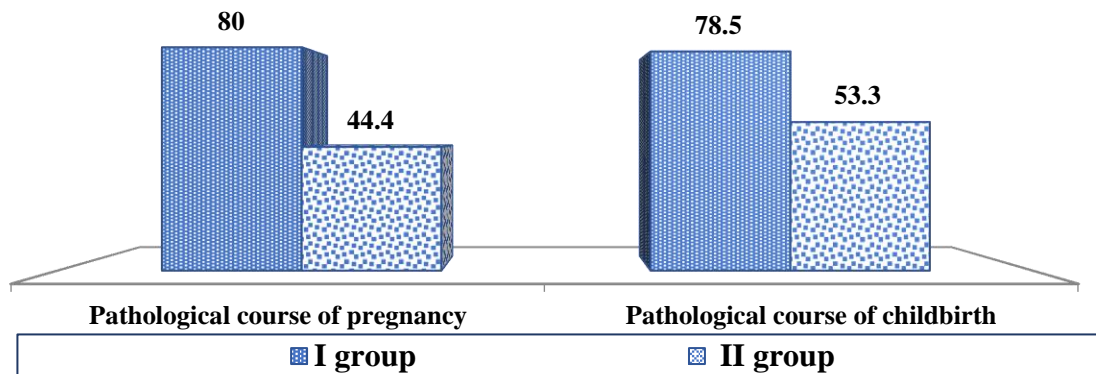


**Fig.1. Automated bronchophonographic diagnostic device "PATTERN-01".**

Registration of respiratory sounds was carried out using a sensor with high sensitivity in the frequency band from 0.2 to 12.6 kHz, including those frequencies that are not recorded by the ear during traditional listening with a stethophonendoscope. The process of recording respiratory sounds was carried out with calm breathing for 4 s: in children under one year old - in the "lying" position, in children older than a year old - sitting with a mask. The procedure for recording respiratory sounds during quiet breathing was repeated several times until 3 reproducible results were obtained. When determining the indicators of CBPG, the standards developed in the course of a bronchophonographic examination of healthy children in the control group were used.

## RESULTS AND DISCUSSION

In a comparative assessment of clinical and anamnestic data, aggravating factors were identified in most children who had CB and BA. It was found that in children of group I, 2 times more often than in group II, an unfavorable course of the antenatal and / or intranatal periods of development was noted (preeclampsia in the 1st and 2nd half of pregnancy, the threat of premature birth, ARI during pregnancy, exacerbation of chronic diseases, anemia in the mother, etc.) (respectively, in 52 (80.0%) and 20 (44.4%);  $p < 0.05$ ) (Fig. 2). The pathological course of labor occurred in 51 (78.5%) children of group I and in 24 (53.3%) children of group II ( $p < 0.05$ ). In group I, delivery by caesarean section was more common (respectively, in 15.4 and 6.6%;  $p < 0.05$ ); cord entanglement during childbirth (respectively, in 13.8 and 4.4%;  $p < 0.05$ ); rapid labor (respectively, 9.2% and 4.4%;  $p < 0.05$ ). Premature (35-37 weeks) were born 6.2% of children of group I and 11.1% of children of group II ( $p < 0.05$ ). The combination of the above data negatively affects the formation of the functional systems of the body, including the respiratory system.



**Figure 2. The frequency of the pathological course of the antenatal and intranatal periods of development in children in the study groups.**

Almost every fourth child who had CB and BA lived in unfavorable housing and living conditions (respectively, 26.1 and 24.4% of children;  $p>0.05$ ). In 41.5% of children of group I and 37.7% of children of group II, crowding was noted in the place of residence. In groups of patients with CB and BA, especially in group I (respectively, 69.2 and 66.6%;  $p>0.05$ ), a high incidence of passive smoking was noted, which negatively affected the functional state of the respiratory organs. In group I, hereditary burden according to an allergic history was manifested by the presence of asthma - in 52.3% of families, atopic dermatitis - in 26.1%, allergic rhinitis in 7.6%, pollinosis in 4.6%, in 13.8% of families it was noted combined allergic pathology. In 40.0% of cases, allergic diseases were observed in the relatives of the child on the mother's side, in 18.4% of cases - in relatives on the father's side. In 10.7% of cases, allergic pathology was diagnosed in the brothers and sisters of the child, in 23.1% of cases - in the mother, in 10.7% of cases - in the father of the child. Allergic diseases in 2 or more relatives in 2 or more generations (significant hereditary predisposition to allergic diseases) were determined in 15.4% of children. In patients of group I, a burdened allergic history was observed. So, 23.1% of children in this group were diagnosed with atopic dermatitis, 15.4% - acute allergic reactions in the form of acute urticaria, Quincke's edema.

Important information was obtained from the analysis of acute respiratory morbidity, characterizing the level of resistance of children in the observation group. It was noted that the majority of children of groups I and II began to suffer from ARI already in the first year of life (87.7 and 77.7 children, respectively;  $p>0.05$ ). The first episode of BOS in most children of groups I and II developed in the first year of life (respectively, in 76.9 and 71.1% of children;  $p>0.05$ ), the average age of the first episode of BOS in group I was  $6.3 \pm 0.5$  months, in group II  $6.0 \pm 0.5$  months. ( $p>0.05$ ). Repeated episodes of biofeedback were most often observed in patients of group I compared with group II (67.6% and 42.2%, respectively;  $p<0.05$ ). A more frequent incidence of ARI at 1 year of age was observed in children of group I (respectively,  $6.7 \pm 0.2$  and  $8.4 \pm 0.2$  times a year;  $p<0.05$ ) (Fig. 2).

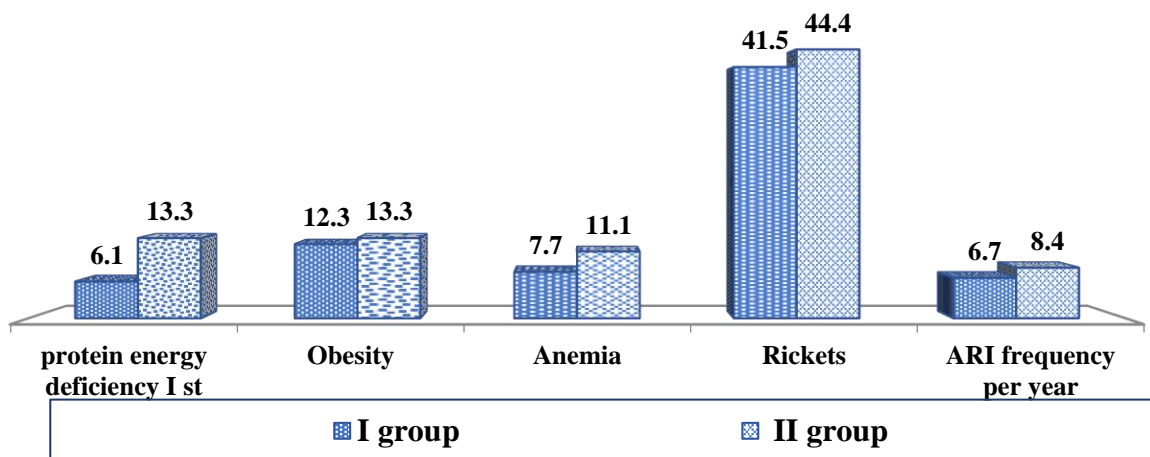


Figure 2. Frequency of occurrence of background conditions in children, (%)

Upon admission to the hospital, all children complained of an unproductive cough, expiratory dyspnea, and fever. In group I, more often the body temperature did not rise above subfebrile (respectively, in 61.6 and 22.2%;  $p < 0.05$ ). On examination, all children revealed chest swelling, participation in the act of breathing of auxiliary muscles, retraction of the intercostal spaces. It was noted that in almost half (41.5%) of children of group I, BOS was accompanied by respiratory failure of 1-2 degrees with a decrease in oxygen saturation in the blood with pulse oximetry less than 93%, and only in 8.8% of children of group II ( $p < 0.05$ ).

In all children, a boxed shade of lung sound without locality was determined percussion. During auscultation, hard breathing, prolonged wheezing, diffuse dry whistling rales on both sides, in some children - moist medium bubbling rales were heard. In children of groups I and II, there were no significant differences in the duration of biofeedback. When examined in a hospital, 41.5% of group I and 44.4% of group II, at the age of 1 year, were diagnosed with rickets of I and II degrees ( $p > 0.05$ ), mild deficiency anemia (respectively, in 7, 7 and 11.1%;  $p > 0.05$ ), obesity (respectively, 12.3 and 13.3%;  $p > 0.05$ ), protein-energy malnutrition (BENP) I degree (respectively, in 6.1% and in 13.3%,  $p < 0.05$ ) (Fig. 2).

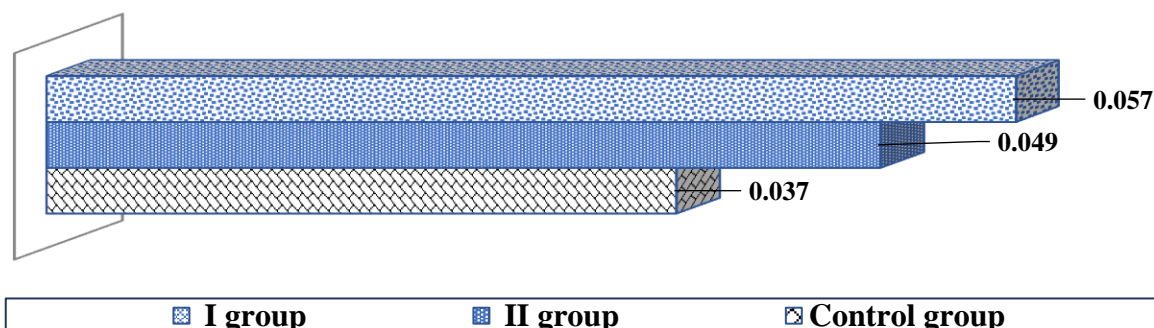
Acoustic characteristics of breathing in children were determined after BFB relief, on the 6th-10th day of hospital stay. As a result of the analysis of the acoustic characteristics of breathing using computer bronchophonography (CBPH) in children with CB and BA, an increase in the level of the acoustic component of the work of breathing in the full frequency range (AKRDtot), AKRD in the mid-frequency (AKRD2) and high-frequency (AKRD3) ranges was noted (Table 1). 1), as well as the AKRD coefficients in the mid- and high-frequency ranges ( $\varphi_2$  and  $\varphi_3$ ) compared with the control group ( $p < 0.05$ ).

Index	I group(n=106)	II group(n=74)	Controlgroup(n=54)
AKRDtot, $\mu J$	8,46±2,93*.#	5,16±1,37*.#	3,22±0,32#
AKRD1, $\mu J$	6,44±2,66*.#	3,36±0,90*	3,35±0,95#
AKRD2, $\mu J$	1,83±0,32#	1,64±0,44#	0,64±0,19#
AKRD3, $\mu J$	0,37±0,16*.#	0,16±0,06*.#	0,02±0,002#
Rel. amplitude level of high-frequency oscillations	0,05±0,001*.#	0,04±0,01*.#	0,03±0,004#
$\varphi_1$	0,65±0,02#	0,63±0,03#	0,80±0,016#
$\varphi_2$	0,31±0,02#	0,33±0,03#	0,18±0,01#
$\varphi_3$	0,032±0,003#	0,031±0,004#	0,009±0,001#

Reliability of differences in indicators  $p < 0.05$  (according to the Mann-Whitney test): \* - between groups I and II; # - between groups of patients and practically healthy children;



Moreover, children with BA (group I) had a higher level of AKRD<sub>total</sub>, AKRD<sub>1</sub>, AKRD<sub>3</sub>, in contrast to group II ( $p < 0.05$ ).



**Figure 3. Comparative assessment of the relative level of high-frequency oscillations depending on the severity of the amplitude of the allergic history**

During the analysis of the amplitude acoustic characteristics of respiratory sounds in the high-frequency range, it was noted that in patients of groups I and II, the relative level of the amplitude of high-frequency oscillations was significantly higher ( $0.057 \pm 0.008$  and  $0.049 \pm 0.010$ , respectively) compared to practically healthy children ( $0.037 \pm 0.004$ ) ( $p < 0.05$ ) (Fig. 3).

Thus, based on the characteristics of the clinical picture in children with CB and BA, repeated (4-6) episodes of BOS with a severe course, as well as its long-term relief, were identified. In children with BA and CB, there are changes in the functional parameters of the respiratory system (according to KBFG), in the form of a high level of AKRD<sub>total</sub>, AKRD in the mid-frequency and high-frequency ranges, an increase in the amplitude of high-frequency oscillations that persist in the period of convalescence. The revealed changes indicated latent (in the absence of clinical manifestations) bronchial obstruction and bronchial hyperreactivity in these patients.

## CONCLUSION

1. In children with a burdened allergic history, who had episodes of biofeedback at an early age and had a history of perinatal damage of hypoxic genesis of the 1st degree of severity, a more severe course and prolonged relief of acute bronchial obstruction are noted, in connection with this, such children needed a more comprehensive examination of functional parameters of the respiratory system.
2. Children with CB and BA are characterized by changes in the functional parameters of the respiratory system, manifested by a high level of the acoustic component of the work of breathing in the full frequency range (AKRD<sub>tot</sub>); coefficient of the ratio of AKRD in the high-frequency range to AKRD<sub>tot</sub>. ( $\phi_3$ ), indicating latent (in the absence of clinical manifestations) bronchial obstruction and the presence of bronchial hyperreactivity. Functional changes in the acoustic component of the work of breathing in children with chronic bronchitis and asthma, according to the CBFG data, correlate with the duration and severity of broncho-obstructive syndrome. At the same time, these changes in patients with a burdened allergic history were significantly more pronounced than in children without a burdened allergic history, which should be alarming regarding the early onset of bronchial asthma.

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