

PEDIATRICS

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THE FEATURES OF NUTRITIONAL STATUS IN CHILDREN WITH BRONCHOPULMONARY DYSPLASIA

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Abstract: The features of nutritional status of children with bronchopulmonary dysplasia were analyzed based on the analysis of anthropometric data and laboratory findings. The children with bronchopulmonary dysplasia were shown to have significantly lower physical development indices than healthy ones. Dependence between blood serum hypoproteinemia and pathological changes in the coprogram of children with bronchopulmonary dysplasia was revealed, which should be taken into account during clinical management of this group of children.

KeyWords: bronchopulmonary dysplasia, nutritional status, physical development, children.



INTRODUCTION

The Concept of the State Program «Healthy Child for 2008-2017» notes that the health of children is a priority for the Ukrainian state policy and modern society [1]. However, despite the rapid introduction of new technologies in neonatology, neonatal mortality rates in Ukraine have not diminished [2, 3]. An increase in the proportion of preterm birth is observed in many countries secondary to demographic crisis and deterioration of reproductive and somatic health [4]. This in turn emphasizes the need for a thorough research from the perspective of evidence-based medicine and implementation of the results in health care establishments providing medical care for children from the group of high risk of death or forming a stable combined organic pathology of various organs and systems [4, 5]. Therefore, reducing infant mortality is one of the most important tasks for Ukrainian pediatrics [6]. Of the causes of death of children under 1 year of age, 70% depend on maternal health and access to and quality of health care for women during pregnancy, childbirth and children in the neonatal period [7].

Main problems occurring in children in the neonatal period include hypoxia, respiratory disorders, hypothermia, intraventricular hemorrhage, sepsis, intrauterine infections and others. These conditions result in overstrain of immature non-specific adaptive mechanisms, which was described in 1936 by Hans Selie [3]. Despite the increase in the absolute number of children surviving in intensive care units for newborns over the recent decades, nearly 50% of preterm infants are at risk of chronic disease and disability [8].

2 PURPOSES, SUBJECTS AND METHODS:

2.1 Purpose

The aim of the study was to study characteristics of epichlorohydrin action on the pyloric gland of the stomach, to evaluate the possibility of using Echinacea purpurea extract and Thiotriazoline to correct the changes in pyloric glands.

2.2 Subjects

The study involved 83 children aged from 1 month to 3 years with bronchopulmonary dysplasia. BPD diagnosis was made according to the International Classification of Diseases, 10th revision. Informed consent was signed by the parents prior to the study.

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2.3 Methods

Evaluation of physical development was carried out using centile graphs [20]. The comparison group included 20 age-matched children who were born prematurely, but later did not have clinical and radiological signs of BPD and any chronic disease.

Statistical analysis was performed using statistical package «EXCELL FOR WINDOWS» and «STATISTICA 7.0. FOR WINDOWS» [21]. Depending on the chosen statistical model both parametric and non-parametric methods were used to test the hypotheses of the work. For samples of distribution that did not comply with Gaussian law, median (Me) and interquartile scope (Lq - lower quartile; Uq - upper quartile) were determined. To compare dispersions, Fisher's criterion (F) was used, comparing sample particles, the method of angular transformation with F-test assessment was used. To determine the association between quality characteristics, Pearson χ^2 test (Fisher's exact test in the case of 2x2 tables) was used. The results were considered statistically significant at $p < 0.05$.

Conflict of interests

There is no conflict of interests.

3 RESULTS AND DISCUSSION

Age- and sex-dependent distribution of the examined children is presented in Table 1.

Table 1.

Age- and sex-dependent distribution of the examined children

Indicator	Distribution feature	Children with BPD (n=83)		Controls (n=20)	
		N	%	N	%
Gender	Males	50	60.2	12	60.0
	Females	33	39.8	8	40.0
Age	1 mo - 11mo 29 d	60	72.3	14	70.0
	1 mo - 11mo 29 d	15	18.1	4	20.0
	2 yr - 2 yr 11 mo 29 d	8	9.6	2	10.0

Among the examined children of the main group boys prevailed in the number ($60.2 \pm 5.4\%$ and $39.8 \pm 5.4\%$, respectively; $F = 7.01$, $p < 0.01$). Group age-dependent patterns in children with BPD agreed with the relevant general trends among the investigated children, namely boys prevailed among the children both of the first year of life ($K = 1.72$) and aged 2 - 3 years ($K = 1.66$). This predominance of boys in the group of investigated children corresponds to the literature, according to which bronchopulmonary dysplasia is more common in boys and can be considered one of the unmodified risk factors of bronchopulmonary dysplasia [10, 22].

The study of the age ratio in the investigated groups shows that bronchopulmonary dysplasia was most likely under 1 year of life ($72.3 \pm 4.9\%$; $F = 35.43$, $p < 0.001$). Reduction of the relative number of patients with the age is due to the fact that the clinical manifestations of the disease regress during the growth of the child [10, 22].

Indicators of physical development of children with bronchopulmonary dysplasia are important in assessment of both the severity and prognosis of the disease. The analysis of anthropometric indices revealed that $89.2 \pm 3.4\%$ of children with BPD had disharmonious physical development ($F = 134.8$; $p < 0.001$). Of them, $60.2 \pm 5.4\%$ of children (overwhelming majority, $F = 20.7$; $p < 0.001$) had disharmonious physical development due to low or very low body weight; in $3.6 \pm 2.1\%$ due to great body length. The physical development of the controls was regarded as harmonic mean in the majority of children ($90.0 \pm 6.8\%$). and only in two children as disharmonious due to low body weight (Table 2).

In our opinion, delayed weight gain or growth in children with bronchopulmonary dysplasia may result from low basic growth potential in the neonatal period, which is caused by energy deficiency against a background of mechanical ventilation, higher expenditure for minute pulmonary ventilation, higher metabolism level, prolonged chronic respiratory failure, which is supported by many authors [9, 18, 23-25].

The changes in the physical development of children with BPD do not contradict the known literature data on

slow weight gain, requiring increased caloric intake (140-150 kcal/kg) with sufficient protein content (3.0-3.5 g/kg) [10, 11, 12].

Table 2.

Physical development of children from the both groups

Assessment of physical development	Children with BPD (n=83)		Controls (n=20)		Difference
	N	p %±sp%	N	p %±sp%	
Harmonic	9	10.8±3.4	18	90.0±6.8	F=53.9; p<0.001
Disharmonious:	74	89.2±3.4	2	10.0±6.9	F=53.9; p<0.001
- below average in weight and height	21	25.3±4.8	0	0	F=17.9; p<0.001
- low in weight	50	60.2±5.4	2	10.0±6.9	F=20.7; p<0.001
- tall	3	3.6±2.1	0	0	F=2.35; p>0.05

Objective examination of the digestive system demonstrated in the vast majority of children with BPD (97.6±1.6%; F=263.3, p<0.001) hepatomegaly and in 9 (10.8±3.4%) children splenomegaly. These changes can be related to compensation reaction of the organism to chronic inflammation of the respiratory system. Fifteen (18.1±4.2%) children had predisposition to constipation, most probably of central origin.

Diagnostic measures in children with BPD revealed certain changes in the laboratory findings. The changes in coprogram were detected in the majority of children, i.e. 71 (85.5 ± 3.9%; F = 103.5, p <0.001), of them 45.8% demonstrated undigested or digested fiber, 22.9 % steatorrhea, 21.7% amylorrhoea, 9.6% creatorrhea. These changes may be associated with decreased enzyme-secreting function of the gastrointestinal tract in children born prematurely indicating a lack of absorption function of the gastrointestinal mucosa, which adversely affects a child's development.

According to the literature [26, 27], the patients with bronchopulmonary pathology demonstrate activation of lipid peroxidation processes, which leads to increased levels of cholesterol, β-lipoprotein and is accompanied by decrease in antioxidant activity. In our study 11 (13.3 ± 3.7%) children had marked increase in β-lipoprotein (62.0 (59.0; 68.0) c. u.), 2 (2.4±1. 6%) children increased cholesterol level (7.6 (7.5; 7.7) mmol/l). Fifteen (18.1±4.2%) children had reduction in β-lipoprotein level (28.0 (23.0. 29.0) c.u.) and 14 (16.9±4.1 %) patients increased cholesterol level (2.545 (2.4; 2.7) mmol/l). The increase in alkaline phosphatase (8400.0 (7600.0. 11000.0) nmol/s*l) was noted in 15 (18.1±4.2%) children. Increased transaminases level was observed in 8 (9.6±3.2%) children, alanine aminotransferase (0.810 (0.69; 1.04) mmol/l·h) and aspartate aminotransferase (0.910 (0.560; 1.25) mmol/l·h) being equally increased. These children were conducted investigation for markers of hepatitis B, C, namely HBsAg. HBCAg. HCV. All results were negative, which allowed to exclude the presence of viral hepatitis. In our opinion, these changes in transferase activity can be explained by the reaction of the liver to chronic inflammation of the bronchopulmonary system.

Changes in proteinogram were noticed in 37 (44.6±5.4%) children with bronchopulmonary dysplasia. Of them hypoproteinemia was observed in 28.9±5.0% of children, dysproteinemia in 22.9±4.6% of patients. These changes in children with BPD can be interpreted as the body's response to inflammation or nutritional disorders due to failure in intake of main ingredients or disorders in absorption and digestion functions of the gastrointestinal mucosa.

To clarify these issues tetrachoric indicator was used to analyze the relationship between qualitative criteria: presence or absence of hypoproteinemia and pathological changes in coprogram (amylorrhoea, steatorrhea, creatorrhea) in children with BPD (Table 3). The above calculations led to the conclusion that the level of protein in the serum of children with BPD depends on the digestive function of the gastrointestinal tract (x2 =4.08; p=0.043), disorders of which may be inherent to preterm infants due to immaturity of enzyme systems the gastrointestinal tract

[18, 24, 25]. These factors are not directly associated with the disease, but can significantly enhance severity of its course and sequelae. All this leads to functional load to all organs and systems.

Table 3.

Characteristics of association between hypoproteinemia and abnormal coprogram changes in children with BPD

Feature	Children with BPD (n=49)		χ^2	p
	Group 1 n=6 abs.	Group 2 n=43 abs.		
Reduced protein level	1	26	4.08	0.043
Blood protein level within the norm	5	17		

Note. χ^2 - Pearson criterion to evaluate statistical significance of Pearson coefficient of association; p - level of statistical significance.

If adverse internal or external factors are present, this may result in repeated episodes of the disease exacerbation and development of complications. These findings should be considered when conducting examination, treatment and rehabilitation of this group of patients.

4 CONCLUSIONS

1. The vast majority of children with bronchopulmonary dysplasia ($F=20.7$; $p<0.001$) were characterized by disharmonious physical development due to low or very low body weight, which requires increased calorie intake with sufficient protein content.

2. Blood serum protein level of children with bronchopulmonary dysplasia depends on the digestive function of the gastrointestinal tract, the disorders of which are inherent in preterm infants due to immaturity of the enzyme system of the gastrointestinal tract.

3. Solution of a multifactorial problem of improving the quality of life of children with bronchopulmonary dysplasia is promising, which is possible only if a comprehensive

rehabilitation program including organization of early detection and correction of various disorders in postnatal adaptation of preterm infants is created.

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Received: 21-Apr. - 2016

Accepted: 23-May. - 2016