Original Article

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Peculiarities of Cytokine Status and Biochemical Indicators in Bronchial Asthma in Children

Maftuna Khudoybergan kizi Karimova, Furkat Mukhitdinovich Shamsiev

Republican Specialized Scientific and Practical Medical Center of Pediatrics, Ministry of Health of the Republic of Uzbekistan, Tashkent, Uzbekistan.

Abstract

Background: The article studies the indicators of the cytokine status and determines the features of the hemostasis system and acid-base state in bronchial asthma in children. **Subjects and Methods:** We examined 25 children with bronchial asthma in the period of exacerbation at the age from 7 to 14 years, who received treatment in the department of allergology, the comparison group consisted of 20 patients with bronchial asthma in the remission phase, the control group consisted of 10 practically healthy children of the same age. **Results:** From the side of biochemical parameters, a very low level of prothrombin time, mild metabolic alkalosis, low partial pressure of oxygen in the blood, and a decrease in the concentration of potassium and calcium ions were revealed. **Conclusion:** This is caused by disturbances in the hemostasis system, due to long-term persistent inflammation in the bronchopulmonary system and severe hypoxia.

Keywords: Bronchial Asthma, Cytokine Status, Hemostasis, Acid-Base State, Children.

Corresponding Author: Maftuna Khudoybergan kizi Karimova, Republican Specialized Scientific and Practical Medical Center of Pediatrics, Ministry of Health of the Republic of Uzbekistan, Tashkent, Uzbekistan.
E-mail: Maftuna.karimova1991@bk.ru

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Introduction

Bronchial asthma is one of the most pressing problems in pediatric pulmonology. Despite the available positive results in the study of the pathogenesis, diagnosis and treatment of this disease, there is a steady increase in the incidence and life-threatening complications.[1–4] It is known that the lungs are the central organ of regulation of all links of hemostasis, control and prevention of thrombogenesis.[5,6] In turn, the interaction and activation of blood coagulation factors occurs on the surface of circulating phospholipid membranes.[7] At the same time, the participation of the hemostasis system in immuno-inflammatory processes is beyond doubt, but the complex mechanisms of changes in hemocoagulation and their role in the progression of bronchial asthma in children require further study, since the literature data are very contradictory. In this regard, the disclosure of one of the possible mechanisms contributing to the prolongation of allergic inflammation in the bronchopulmonary system from the standpoint of studying the coagulo-fibrinolytic link of hemostasis in relation to the lipid spectrum, acid-base composition, respiratory and metabolic activity of the lungs will make it possible to scientifically substantiate the need to develop a substantiated therapeutic correction in children with bronchial asthma.

Another of the main links in the pathogenesis of bronchial asthma are immune mechanisms.[8–11] Cd4 + lymphocytes play a key role in body sensitization. Under the influence of allergenic stimuli, activation and proliferation of the th2 subpopulation of cd4 + lymphocytes occurs, followed by the release of cytokines by them, inducing overproduction of general and specific ige. Re-entry of an allergen leads to the release of mediators by cells after nonspecific stimulation or binding of allergens to ige on the surface of mast cells. These mediators (histamine, leukotrienes) cause the development of an allergic response, manifested by impaired bronchial patency and an asthma attack.

The participation of the hemostasis system in immune-inflammatory processes is beyond doubt, but the complex mechanisms of changes in hemocoagulation and their role in the progression of bronchial asthma in children require clarification, since the literature data are very contradictory and ambiguous. Revealing the pathogenetic mechanisms of bronchial asthma will help to better understand the pathology and will make it possible to develop a set of measures in a timely manner to reduce the frequency of exacerbations of the disease.[12–15]

The aim of the study was to study the indicators of the cytokine status and determine the features of the hemostasis system and acid-base state in bronchial asthma in children.

Subjects and Methods

We examined 25 children with bronchial asthma in the period of exacerbation at the age from 7 to 14 years, who received treatment in the department of allergology, the comparison group consisted of 20 patients with bronchial asthma in the remission phase, the control group consisted of 10 practically healthy children of the same age.

When diagnosing asthma, the classification adopted by the gina program in 2020 was used. The basis for the diagnosis was: complaints, anamnesis data, the results of general clinical, immunological and functional research methods. Immunological studies were carried out at the institute of immunology and human genomics. The research program included: determination of the level of cytokines: il-1β and il-8, by enzyme immunoassay. The conducted biochemical studies include: determination of the activity of the acid-base state of the blood.

Results and Discussion

The important factors that determine the state of health of the child and his development are the features of the obstetric history, the condition of the child at birth and his development before the onset of the present disease. Analyzing the complete information on the anamnesis of the examined children, we identified the risk factors that were most common in them. 22 (48.8%) patients with bronchial asthma were born from the first pregnancy, 25 (37.7%) from II-III pregnancies, from IV and more - 6 (13.3%) children. 39 (86.6%) mothers had various complications during pregnancy. The threat of termination of pregnancy was in 19 (42.2%), acute respiratory infections during pregnancy were suffered by 36 (80.0%) mothers, anemia - in 37 (82.2%), pathological course of childbirth - in 34 (75.5%). %) of cases, prematurity and birth in asphyxia - in 6 (13.3%) and 23 (51.1%), respectively. Upon admission to the hospital, the main complaints of children with bronchial asthma in 100.0% of cases were cough with a small amount of predominantly mucous sputum, especially on awakening, shortness of breath in 100.0% of children, loss of appetite in 80.0%, lethargy in 40, 0%, asthma attacks in 80.0% of the subjects, oral wheezing in 80.0%, sweating in 50.0%, headache in 45.0% of patients.

The development of a disease with an immunopathogenetic basis should be considered from the point of view of the effector links of the immune system, whose participation in pathological processes is largely due to the cytokine cascade. To identify the features of the immune status and its role in the pathogenesis of bronchial asthma, it seemed interesting to us to study the cytokine status. The study of cytokines showed that in practically healthy children, the production of IL-1 fluctuated insignificantly (14–69 pg / ml) and averaged 52.4 ± 3.5 pg / ml. In patients with bronchial asthma during the onset period, the IL -1 values were significantly increased and reached 96.8 ± 5.7 pg / ml ($P < 0.01$). IL-8 indices in the group of children with bronchial asthma in the period of remission were 19.8 ± 1.4 pg / ml. The study of cytokines showed that in patients with bronchial asthma during the onset period, the levels of IL-1 and IL-8 were significantly increased compared with the indicators in the group of children with bronchial asthma during the period of remission ($P < 0.01$). According to our data, the spontaneous production of IL-8 in patients is 3.7 times higher than in the control ($P < 0.001$).

The study of the coagulogram showed that the study group had a high level of prothrombin index (125.48 ± 1.57), and the control group did not exceed the norm ($P < 0.01$). The study of the acid-base composition showed that the result of bronchial obstruction was a change in the activity of the reaction of the internal environment, the main manifestation of which was arterial hypoxemia. Thus, in patients with bronchial asthma during the onset period, PO2 (55.5 ± 6.16 mm Hg), SO2 (83.9 ± 5.13%) were significantly lower ($P < 0.05$) than similar indicators. in children from the control group (PO2 = 82.4 ± 2.9 mm Hg; SO2 = 93.6 ± 4.2%). At the same time, blood pH indices in children during the seizure period were slightly higher than normal (7.45 ± 0.02), and in the control group it was within the normal range (7.38 ± 0.04), ($P < 0.01$) ... Changes in the electrolyte composition of the blood were also noted. The level of potassium (K +) in the study group was (3.09 ± 0.159 mmol / l), which is below normal, and in the control group (4.43 ± 0.2 mmol / l), ($P < 0.01$). The level of calcium (Ca ++) in the study group was almost two times lower than normal (1.01 ± 0.05 mmol / L), and in the control group (2.1 ± 0.3 mmol / L), (P <0, 01).

Conclusion

Thus, the development of bronchial asthma is facilitated by the unfavorable course of the peri- and intranatal periods, aggravated premorbid background, concomitant and past diseases that greatly aggravate the course of the underlying pathology, and the revealed significantly high levels of pro-inflammatory cytokines IL-1β and IL-8 in the blood serum. According to biochemical parameters, in patients with bronchial asthma from the side of the coagulogram, a high level of the prothrombin index was revealed, from the side of acid-base balance, mild metabolic alkalosis, a low level of partial pressure of oxygen in the blood were determined, a decrease in the concentration of potassium and calcium ions was noted in the electrolyte composition of the blood. This suggests that disorders in the hemostatic system are caused by

long-term persistent inflammation in the bronchopulmonary system and severe hypoxia.

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