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DISORDERS OF METABOLIC ACTIVITY OF INTESTINAL MICROFLORA IN YOUNG CHILDREN

Resume: The metabolic activity of the intestinal microflora and the content of secretory immunoglobulin A (sIgA) in the coprofiltrate in children with rotavirus infection (RI), depending on the nature of the course of the disease, were studied. It was found that the inhibition of metabolic processes of microbiocenosis and the insufficiency of local immunity, which persist for a long time during the disease, determine the non-smooth nature of the course of RI.

Key words: intestinal microflora, metabolic activity, early childhood.

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НАРУШЕНИЯ МЕТАБОЛИЧЕСКОЙ АКТИВНОСТИ КИШЕЧНОЙ МИКРОФЛОРЫ У ДЕТЕЙ РАННЕГО ВОЗРАСТА

Резюме: Исследована метаболическая активность микрофлоры кишечника и содержание секреторного иммуноглобулина А (sIgA) в копрофильтрате у детей ротавирусной инфекцией (РИ) в зависимости от характера течения заболевания. Установлено, что длительно сохраняющееся в течение болезни угнетение метаболических процессов микробиоценоза и недостаточность местного иммунитета определяют негладкий характер течения РИ.

Ключевые слова: кишечная микрофлора, метаболическая активность, раннный детской возраст.

Relevance. Intestinal microflora is considered today as the most important factor that significantly affects the parameters of human health [1,6]. At the present stage, a number of proofs have already been obtained about the connection of microbiocenosis with the development of allergic diseases, pathology of the gastrointestinal tract, cardiovascular system, including atherosclerosis, obesity, diabetes mellitus, oncopathology, autoimmune diseases, and these issues continue to be intensively studied [2,7]. Such a significant effect of the microbiota on the human body is due to its huge metabolic potential, realized mainly due to the mucosal flora colonizing the parietal zone of the intestinal mucosa.

The latter, according to various authors, accounts for a much larger proportion of the relatively clear flora and is directly related to the formation of biofilm [1,3]. The adhered colonies of microorganisms on the intestinal wall form a microbial-tissue complex, including microcolonies of bacteria, metabolites produced by them, mucin, glycocalyx, epithelial cells and mucosal stroma cells, within which there is a constant exchange of genetic material, signaling and regulatory molecules, metabolites [1].

One of the most significant low-molecular metabolites are short-chain fatty acids (FFA) (acetic, propionic, butyric, etc.), which affect the adhesion of pathogenic and conditionally pathogenic flora, the parameters of local immunity, the processes of proliferation and differentiation of colonocytes, participate in the regulation of ion exchange, microcirculation, mucus secretion, fill the energy needs of the epithelium, reflect various processes occurring in the large intestine [1, 3, 4].

Evaluation of the spectrum of short-chain fatty acids is an integral indicator of the state of the intestinal microbiome, since bacteriological fecal culture gives an idea to a greater extent about the lumen flora of the large intestine [1, 4, 5]. With the combined influence of various adverse environmental factors (ecology, operative delivery, separation from the mother,

irrational use of broad-spectrum antibiotics in young children, and the most important role belongs to the nutrition factor), the process of primary colonization of the baby's intestines is characterized by a decrease in species diversity, unstable population numbers, insufficient functional activity of representatives of the microbiota [6-8].

Under these conditions, the nutrition factor in young children in order to optimize the processes of colonization of the mucosal flora and its functional activity is of great practical interest. In this regard, it becomes relevant to study the features of the formation and metabolic activity of the microbiota in children of the first years of life, depending on the nature of the introduced complementary foods.

Microbiological examination of the intestinal microflora since the end of the twentieth century is considered as an insufficiently informative diagnostic method that does not reflect its metabolic activity. Chromatographic methods are used to study microflora metabolites: gas-liquid (GC), ionic, high-performance liquid chromatography, gas chromatography-mass spectrometry.

The study of short-chain fatty acids (CLC) by the method of GZHC has high sensitivity and specificity, ease of reproduction, the ability to quickly obtain results. Currently, in the available literature studied by us, there were no data on the normative values of the spectrum of FGC in children aged 0 to 6 months, only reference values in children aged 6 to 12 months are presented.

The purpose of the study. Assessment of the metabolic activity of the intestinal microbiota in children of the first year of life.

Materials and methods of research. The study was conducted in 121 children of the first year of life. Group I consisted of children from 2 to 30 days of life, group II - children from 1-12 months of life.

The results of the study. When analyzing the primary data on the quantitative and qualitative content of short-chain fatty acids in the feces of children (n=103), 2 types of metabolic profile were registered: anaerobic type -

in 70% of children and aerobic type - in 30% of children. Both types of changes in the functional activity of the microbiota were characterized by the presence of a tendency to decrease the absolute total content of short-chain fatty acids in feces relative to reference indicators with the most significant decrease in children with aerobic type. The revealed features seem to be associated with a decrease in the number and activity of representatives of obligate microflora, which is consistent with the data of other authors.

When assessing the levels of acetic, propionic and butyric acids, which form the basis of the entire pool of short-chain fatty acids, the following results were obtained: with an anaerobic profile, there was a significant decrease in the levels of acetic and an increase in propionic and butyric acids; with an aerobic type, there was a significant increase in acetic and a decrease in propionic and butyric acids ($p<0.05$ when compared with reference values).

These features of the spectrum of acids may be due to hypercolonization and increased activity of anaerobic flora with a predominance of butyric acid and propionic acid fermentation, characteristic of bacteria genera of bacteroids, propionobacteria, fusobacteria, eubacteria, and increased growth of clostridium, producers of propionic and butyric acids. And, accordingly, in the aerobic type - activation of aerobic microorganisms, representatives of facultative and residual microflora, producing mainly acetic acid.

The anaerobic index, calculated as the ratio of the sum of the concentrations of all acids to the concentration of acetic acid, is the most important indicator of the state of the intestinal environment and reflects the ratio of anaerobic and aerobic, including facultative anaerobic microbiota populations. When evaluating it, a sharp shift of the index was registered towards negative values for the anaerobic type and into the zone of opposite values for the aerobic type ($p<0.05$ when compared with reference values for both acid profiles), which may indicate an increase in anaerobic or aerobic populations, respectively, against the background of a decrease in the activity of

obligate flora due to the suppression of ferredoxin-containing respiratory enzymes that ensure their normal functioning

The level of acetic acid (C2) in the feces in general in all children was 0.794 ± 0.01 mg/g: in group I — 0.839 ± 0.034 mg/g, in group II - 0.779 ± 0.012 mg/g. The maximum value was observed in 3-6 months — 0.823 ± 0.028 mg/g. Differences in the content of C2 in feces were revealed between newborns and children 6-12 months (p 0.02), between children 3-6 and 6-12 months (p 0.04). Propionic (C3) and butyric (C4) acids in all children were 0.126 ± 0.01 and 0.079 ± 0.01 mg/g, respectively.

The highest level of C3 was observed at 6-12 months, the lowest values — in children from 3 to 6 months. A positive relationship was found between the level of C3 and age ($r = 0.27$; $p < 0.05$). The content of C4 in the feces of newborns was 0.046 ± 0.023 mg / g, in children 1-12 months - 0.091 ± 0.01 mg / g (p 0.02); the maximum value of C4 - 0.114 ± 0.02 mg/ g - was noted at 6-12 months. A tendency to increase the level of C4 in feces with age was revealed. The total acid content in feces was 6,908 ± 0.67 mg/g: in group I 10,379 ± 1.87 mg/g, in group II - 5,764 ± 0.61 mg/g (p 0.02).

The lowest total acid content is in children 3-6 months (2.285 ± 0.05 mg/g). By 1 year of life, the total content of FFA decreased ($r = -0.365$; $p < 0.005$). The anaerobic index as a whole was 0.319 ± 0.04 mg / g, the maximum value — in children 6-12 months, the lowest - in 3-6 months.

The peculiarities of the formation of the functional activity of the microbiota in children of the second half of life are characterized by the presence of two types of metabolic profiles -anaerobic (70% of patients) or aerobic (30%). The intake of fermented dairy products enriched with bifidobacteria in comparison with an unenriched product is accompanied by a more significant positive effect on the processes of formation of the metabolic activity of the intestinal microbiota in young children. It was revealed that bioprostokvasha is most effective in the anaerobic type of metabolic activity

profile, and bioryazhenka is most effective in the aerobic type. The latter can be used for a differentiated approach to product selection in order to correct various types of disorders of the functional activity of the microbiota and disorders of intestinal motility.

Conclusion. The observation suggests that fermented dairy complementary foods with a given composition and properties can contribute to the processes of formation of microbiocenosis and functional activity of the microbiota in young children. Assessment of the type of metabolic disorders facilitates the selection of the optimal complementary food product, taking into account the identified metabolic features. The effectiveness and good tolerability of fermented milk products obtained using a starter culture based on metabolically active strains of bifidobacteria indicates the possibility of their widespread use for optimizing baby food at the regional level in order to prevent violations of microbiocenosis.

The metabolic activity of the gut microbiota changes with the age of the child. The marker of obligate microflora C2 has higher values in newborns. The marker of "anaerobization— - C3 - tends to increase, the level of C4 - a significant increase from the period of newborn to 1 year of life.

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