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The Role of Probiotics in Metabolic Disorders

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Abstract: The gut microbiota has been studied and continues to be a developing area in the pathognomic development of metabolic diseases like diabetes. Treatment with diet changes, the addition of supplements like prebiotics/probiotics, and the impact of fecal microbial transplantation can be correlated to targeting changes in dysbiosis. These areas of study are crucial to understanding the pathognomic aspects of diabetes disease progression at the microbial level of metabolic and inflammatory mechanisms, which may give more insight into focusing on the role of diet prebiotic/probiotic supplements as potential forms of prospective management in diabetes and the development of more agents that target gut microbiota, which harbors low-grade inflammation. Intestinal dysbiosis was consistently observed in the mechanism of gut microbial change in diabetic individuals, contributing to reduced insulin sensitivity and poor glycemic control. We studied gut microbiome changes in type 2 diabetic patients and concluded that long-term therapy with probiotics in combination with the treatment of the underlying pathology is recommended, where the leading role was assigned to the Lactobacillus rhamnosus strain.

Keywords: Diabetes Melitus type 2, Hyperglycemia, Probiotics, Gut microflora

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Introduction:

According to data presented by the International Diabetes Federation - IDF in 2021, the number of people with diabetes in the world is 537 million, and if this trend continues, the number of people with diabetes will reach 783 million by 2045. Type 2 diabetes is the most common form of diabetes, 95% of all diabetes cases are type 2 diabetes. According to world statistics, prediabetes, or a pre-diabetes condition, is very common. Forms of prediabetes include impaired fasting glycemia and impaired glucose tolerance. Insulin resistance can also be considered one of the forms of prediabetes. According to recent studies, the intestinal barrier plays a crucial role in the development of obesity and type 2 diabetes. [1] The integrity of the intestinal barrier maintains the function of the mucosa, which is very important in the formation of defense mechanisms. Fig.1

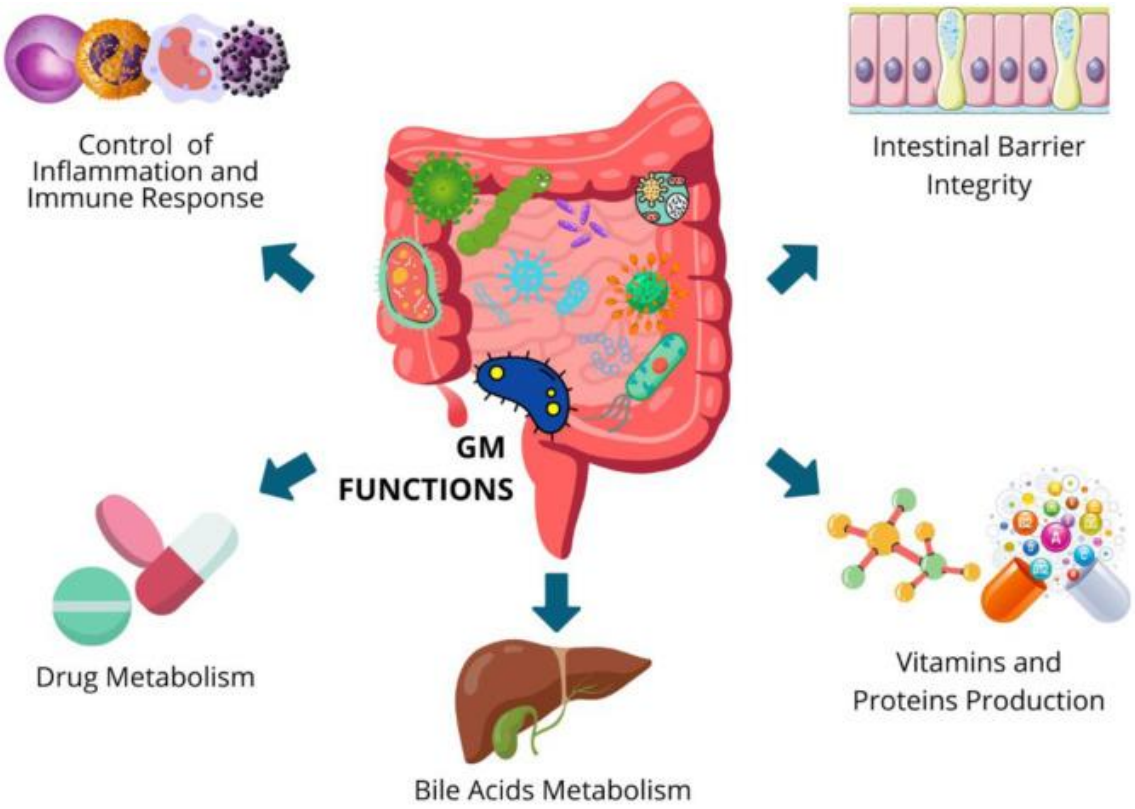

Fig. 1 Gut microbiota functions. The Gut microbiota is involved in the production of secondary bile acids (BAs) and protein catabolism, degradation of xenobiotics, production of water-soluble vitamins, in the control of inflammation and immune response, and in the maintenance of intestinal barrier integrity.[2]

Study Design:

We studied the changes in carbohydrate metabolism in patients with type 2 diabetes mellitus and insulin resistance by restoring the intestinal flora. We included 132 patients in the study, of whom 98 patients had type 2 diabetes mellitus and 34 patients had insulin resistance. Before the study, most of the patients studied with a questionnaire on gastrointestinal complaints suffered from several symptoms, namely: flatulence, diarrhea, constipation, nausea and a feeling of rapid satiety.

Research results:

After the inclusion of probiotics in the treatment (Bifidobacterium bifidum, Bifidobacterium breve, Bifidobacterium longum, Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus plantarum, Lactobacillus rhamnosus, Lactobacillus lactis ssp. Lactis, Streptococcus thermophilus- 20 X109 6 capsules per day for 12 weeks), a decrease in complaints was observed, which should be due to the correction of pronounced dysbacteriosis (confirmed by bacteriological examination of feces before treatment), which is also confirmed by literature data.[3]

According to the results of our study, in patients with type 2 diabetes mellitus, glycated hemoglobin decreased by 0.24% against the background of unchanged antidiabetic therapy, using only probiotics, which can be explained by the following mechanisms: an improvement in the intestinal mucosal barrier developed. As is known from the literature, probiotics regulate intestinal permeability, strengthen the connection between individual enterocytes, against the background of which toxins and other undesirable bacteria no longer easily pass into the blood, which accordingly reduces endotoxemia, and endotoxemia, in turn, may be a source of systemic chronic inflammatory processes. One of the possible mechanisms of the development of type 2 diabetes mellitus is precisely the chronic chronic inflammation. We think that there is another mechanism that provides an improvement in glycated hemoglobin. In particular,

increasing the production of GLP-1 by the intestine, as is known, in type 2 diabetes mellitus, the level of incretins in the body decreases, and incretins, in turn, are glucose regulators. According to existing data, certain types of probiotics have an effect on incretins, namely, they indirectly increase the level of GLP-1 in the blood. GLP-1 stimulates the beta cells of the pancreas to produce insulin.

We evaluated the change in the HOMA index, as a marker of insulin resistance, before and after treatment with probiotics. Insulin resistance decreased by an average of 34.42% with the use of probiotics. The decrease in insulin resistance, in our opinion, occurred for the following reasons: probiotics affect appetite and energy expenditure, increasing the production of acetate, propionate and butyrate, which are short-chain fatty acids – SCFA [4] The use of probiotics regulates the intestinal microbiota by increasing the number of Bifidobacterium and Lactobacillus, which are responsible for the production of SCFA. It is also believed that some probiotics may inhibit the absorption of dietary fats, increase the amount of fat excreted in the feces. According to the literature, they release appetite-regulating hormones, probiotics may promote the release of appetite-suppressing hormones, namely glucagon-like peptide-1 (GLP-1) and peptide YY (PYY). Increased levels of these hormones lead to the burning of calories and fat. Probiotics may also increase levels of fat-regulating proteins, which may lead to a decrease in fat storage.

There is an important link between obesity and inflammation . By improving the intestinal mucosa, probiotics reduce systemic inflammation, thereby reducing the risk of developing obesity. One of the geneses of obesity is precisely the systemic inflammation process. It has been shown that some probiotics, e.g. Bifidobacterium spp. and Lactobacillus spp. produce healthy conjugated linoleic acid (CLA) . CLA affects body weight by improving energy metabolism and lipolysis. In addition, probiotics increase the number of Akkermansia muciniphila, which has a positive effect on mucosal thickness and intestinal barrier integrity. The beneficial effect is associated with a decrease in serum LPS levels and an improvement in the metabolic profile (decrease in plasma total cholesterol, LDL cholesterol and triglycerides and an increase in HDL cholesterol). In addition, probiotics have a beneficial effect on Faecalibacterium prausnitzii populations, which have anti-inflammatory effects. On the other hand, probiotics produce bacteriocins and organic acids, which create an unfavorable environment for the growth of opportunistic pathogens and their metabolites, e.g. LPS and indole . Increased intestinal wall permeability leads to an increase in plasma LPS levels and an increase in the expression of proinflammatory cytokines. Cytokines contribute to insulin resistance, oxidative stress, and increased visceral fat deposition . Probiotics strengthen/strengthen the intestinal barrier, increase the production of tight junction proteins and mucins. Probiotics help reduce adipocyte size by reducing fatty acid absorption and increasing the expression of genes related to fatty acid oxidation. Lactobacillus rhamnosus GG (LGG) inhibits fat accumulation in the liver by phosphorylating AMPK Lactobacillus stimulates the production of certain cytokines, such as tumor necrosis factor alpha (TNF-α), and therefore may be effective in regulating leptin gene expression. Leptin and adiponectin are potent anorexigenic hormones that inhibit food intake by acting on receptors in the central nervous system [5]

The average weight in the insulin-resistant group decreased by 2.2% with the use of probiotics, which can be explained by the reduction in insulin resistance, presumably due to the fact that insulin was fully absorbed by the cell. The weight loss was observed because excess insulin promotes anabolic processes, that is, the development of excess weight and obesity, causing the accumulation of excess fat in the body. Against the background of probiotic treatment, the bacteriological analysis of feces improved dramatically, the number of lactobacilli and bifidobacteria was fully restored. Considering that the probiotics we selected included all beneficial strains, this change was expected.[6]

Conclusion: It is recommended to conduct a detailed assessment of dyspeptic complaints in patients with diabetes mellitus and insulin resistance, examine and correct the intestinal microflora of patients in order to increase the quality of life of patients. In order to improve the effect of treatment in patients with diabetes mellitus and insulin resistance, long-term therapy with probiotics in combination with the

treatment of the underlying pathology is recommended, where the leading role was assigned to the Lactobacillus rhamnosus strain.

Literature

1. N. Yoshida, T. Emoto, T. Yamashita, и et al, «Bacteroides vulgatus and Bacteroides dorei reduce gut microbial lipopolysaccharide production and inhibit atherosclerosis», Circulation, т. 138, сс. 2486–2498, 2018.
2. T. P. M. Scheithauer, E. Rampanelli, M. Nieuwdorp, и et al, «Gut microbiota as a trigger for metabolic inflammation in obesity and type 2 diabetes», Front. Immunol., т. 11, с. 571731, 2020.
3. H. K. Pedersen, V. Gudmundsdottir, H. B. Nielsen, и et al, «Human gut microbes impact host serum metabolome and insulin sensitivity», Nature, 2020.
4. T. Inagaki, A. Moschetta, Y. K. Lee, и et al, «Regulation of antibacterial defense in the small intestine by the nuclear bile acid receptor», Proc. Natl. Acad. Sci. USA, т. 103, сс. 3920–3925, 2006.
5. A. Tirosh, E. S. Calay, G. Tuncman, и et al, «The short-chain fatty acid propionate increases glucagon and FABP4 production, impairing insulin action in mice and humans», Sci. Transl. Med., 2019.
6. L. Crudele, E. Piccinin, и A. Moschetta, «Visceral adiposity and cancer: role in pathogenesis and prognosis», Nutrients, т. 13, с. 2101, 2021.