Introduction
Many studies have found that impaired gut microbiota is an important component of the development of irritable bowel syndrome (IBS). Throughout the gut, microbiota plays an important role in the normal functioning of the gut. Molecular technologies have established the dominance of four classes of microorganisms: Firmicutes (64%), Bacteroidetes (23%), Proteobacteria (8%), Actinobacteria (3%) [1].

In recent decades, a large number of studies have been conducted to investigate the incidence of dysbiosis in patients with IBS, as well as the nature of changes in the individual composition of the gut microbiota. In a famous study by Casén C. et al. (2015), which was conducted in Sweden, Norway, Denmark and Spain, intestinal dysbiosis was detected by genetic methods in 73% of IBS patients and 16% of healthy individuals [2].

The studies examining the species composition of microbiota in IBS have shown varied results, given the different techniques used in these studies. However, the general trend is a decrease in Firmicutes and Bacteroidetes with different ratios depending on the form of IBS. Among these classes of bacteria, the content of Lactobacillus and Bifidobacterium species, mainly lactic acid bacteria, is more often registered in patients with diarrheal form. There is a certain correlation between the concentration of short-chain fatty acids and the content of Bifidobacterium, Lactobacillus, Candida and opportunistic bacteria.

Keywords: irritable bowel syndrome; gut microbiota; dysbiosis; short-chain fatty acids
Materials and methods

The study was conducted at the State Institution “Institute of Gastroenterology of the National Academy of Medical Sciences of Ukraine”. The study involved 15 IBS patients. The diagnosis of irritable bowel syndrome was established after a thorough clinical and anamnetic examination, taking into account compliance with the Rome IV criteria (2016) with the exclusion of anxiety symptoms. All patients experienced intestinal pain. Other symptoms include bloating and abdominal distension; some patients presented with anxiety. Attention was first of all paid to the nature of the emptying. According to the Bristol Stool Chart, patients had diarrheal IBS (9 patients) and non-diarrheal forms (with or without constipation) (6 patients).

All patients enrolled in the study were evaluated for SCFA content. The SCFA level was measured by the chromatographic method using the hardware-software complex for medical research based on the gas chromatograph “Chromatec-Crystal 5000” by the method of Guohua Zhao [13]. The quantitative identification of the SCFA fractions (µg/mg) of acetic (C2), propionic (C3), butyric (C4) acids, column calibration, and chromatogram calculation were performed by the method of normalization of peak areas and their fractions according to the standards of “Sigma-Aldrich Acids” (USA).

Besides, all patients underwent bacteriological (cultural) study of feces with the determination of the gut microbiota composition (the content of Bifidobacteria, Lactobacilli, Escherichia, Enterococci, potentially pathogenic and Candida flora). Investigation of the species and quantitative composition of the colonic microbiota was performed using ten-fold dilutions (10^{-1}–10^{-9}) on a standard set of elective and differential diagnostic nutrient media for isolation of aerobic and anaerobic microorganisms.

Results and discussion

According to the results of the determination of faecal SCFA content, the level of acetic acid (C2) in patients with diarrheal IBS varied within a range of 0.0–0.461 µg/mg; the average level was (0.236 ± 0.044) µg/mg. The content of acetic acid (C2) in IBS patients with no diarrhea ranged 0.034–0.251 µg/mg; the average value was (0.120 ± 0.041) µg/mg (p = 0.039).

The concentration of propionic acid (C3) in patients with diarrhea ranged from 0.003 to 0.229 µg/mg; the average value was (0.074 ± 0.028) µg/mg. The propionic acid content (C3) in IBS without diarrhea was 0.010–0.114 µg/mg; the average value was (0.041 ± 0.016) µg/mg (p = 0.162).

The content of butyric acid (C4) in diarrheal form ranged 0.0–0.106 µg/mg; the average value was (0.051 ± 0.012) µg/mg. Instead, the patients with diarrhea-free IBS had an average concentration of butyric acid (C4) of (0.033 ± 0.009) µg/mg, with fluctuations ranging of 0.010–0.060 µg/mg (p = 0.116).

Thus, the concentration of all SCFA in IBS patients is higher in the presence of diarrhea compared with the patients without diarrhea (Fig. 1). It is also noticeable that the acetic acid content is the highest.
Conclusions

1. The faecal concentration of SCFA is higher in IBS patients with diarrhea compared with the patients without diarrheal syndrome.

2. 83.3–88.9 % of patients with various forms of IBS presented with gut dysbiosis; the patients with diarrhea are more likely to have a reduced content of Bifidobacteria and Lactobacilli, and increase of the Candida flora; on the contrary, the decrease in the concentration of SCFA may be established in case of increased potentially pathogenic flora. Further study of the relationship between the state of the gut microbiota, the nature of dysbiotic changes, and the release of SCFA is needed.

Conflicts of interests. Authors declare the absence of any conflicts of interests and their own financial interest that might be construed to influence the results or interpretation of their manuscript.
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Received 10.08.2019
Revised 19.08.2019
Accepted 06.09.2019