GEORGIAN MEDICAL NEWS

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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**,ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენ-ტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ,რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი,მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემა-ჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტო-სურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი,ანათლების შედებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სუ-რათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხო-ური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამული, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი,წელი,ჟურნალის №,პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანე-ლის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა,მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა,რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შე-ჯერება ხდება სააგტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Содержание:

QUANTITATIVE CHARACTERISTICS OF GUT MICROBIOTA IN PATIENTS WITH ARTERIAL HYPERTENSION

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Introduction. The results of recent studies indicate that arterial hypertension (AH) remains one of the most common chronic non-communicable diseases, as well as a leading factor in cardiovascular and general mortality in most countries [1].

Despite significant progress in research on the pathogenesis of hypertension, the study of genetic, epigenetic, humoral, cellular, and metabolic factors in the development and progression of hypertension [2-5], there is a constant increase in its prevalence [1,5]. In accordance with expert forecasts, by 2025 the number of hypertensive patients will increase by 15-20% and reach 1.5 billion people [1]. Therefore, the search for new links in the pathogenesis of hypertension remains an extremely urgent problem.

A new direction in the study of the mechanisms of development and progression of hypertension is the study of the role of gut microbiota (GM), which is of great importance not only in the pathogenesis of gastrointestinal diseases, but also cardiovascular and metabolic diseases [6-9]. According to the results of studies carried out in recent years, the main dysbiotic factors that can play a role in the pathogenesis of hypertension include disturbances in the composition of GM and the ratio of its main phylotypes, an increase in the formation of endotoxin (lipopolysaccharides (LPSs) of the cell wall of gramm-negative bacteria) in the intestines, a disturbances of the integrity of the intestinal barrier and an increase in its permeability to LPSs, the penetration of the latter into bloodstream and the development of the endotoxinemia, an increase formation of trimethylamine N-oxide (TMAO), impairment of the production of short-chain fatty acids (SCFAs) and their bonds with specific receptors [10-13]. It is interesting that even in patients with prehypertension, certain features of the GM composition are revealed, in particular, an increase in the number of Klebsiella spp. and a decrease in the number of bacteria, the main producers of SCFAs, which is typical for patients with formed hypertension [12,14].

However, the data on the relationship between hypertension and abnormalities in GM parameters are contradictory. So, on the one hand, the microbial diversity of the intestine negatively correlates with systolic blood pressure (BP) [10,15], on the other hand, on the contrary, an increase in the microbial diversity of the intestine was revealed in patients with hypertension [16]. There is also no single point of view as to which representatives of GM and their changes are associated with the development of hypertension. That is, the role of GM in the pathogenesis of hypertension requires further study.

The aim of the work is to study the quantitative characteristics of GM in patients with AH - residents of Ukraine in comparison with practically healthy individuals.

Materials and methods. In the conditions of the Department of Hypertension and Kidney Diseases of the Government Institution "L. T. Malaya Therapy National Institute of the National Academy of Medical Sciences of Ukraine" (Kharkiv), 36 patients with AH stage II, 2-3 degrees (20 men and 16 women) aged from 40 to 65 were examined (average age – (50.1 ± 6.2).

In accordance with the goal, the criteria for inclusion in the study were as follows: the patient's written consent to participate, age - from 40 to 65, the presence of stage II hypertension, 2-3 degrees against the background of normal body weight.

Exclusion criteria from the study: symptomatic forms of hypertension, obesity and overweight, myocardial infarction and angina pectoris, heart failure of II-IV functional classes (according to NYHA), congenital and acquired heart defects, atrial fibrillation, diabetes mellitus, chronic kidney disease, stage IIIa and higher, severe concomitant pathology (severe liver disease, gastrointestinal tract, bronchopulmonary and oncological diseases), the use of antibacterial drugs for the last 3 months.

All patients underwent general clinical, laboratory and instrumental examination. Verification of hypertension, its degree, stage, and risk stratification of complications was carried out in accordance with the latest European guidelines [1].

The quantitative composition of the GM was assessed by the polymerase chain reaction (PCR) method with hybridization-fluorescent detection of the results in the real time mode and with the test system "COLONOFLOR-16 (biocenosis)" ("ALFALAB"). PCR was performed with a PCR product detection system in the real time mode - CFX96 Touch (Bio-Rad).

The study of the composition of microbial flora in fecal samples consisted of 2 stages: 1) DNA extractions; 2) amplification of specific DNA dishes by PCR method with hybridization-fluorescent detection of amplification products in real-time mode. To carry out the reaction, specific oligonucleotide primers and specific oligonucleotide probes Taqman were used.

An analysis of the given data is sent to the file for some processing of the results, which is included in the set (Kolonoflor_17_10.exe). The calculation for each indicator was performed using a formula that describes the dependence of the threshold cycle Ct on the initial concentration of the DNA fragment. The conversion of the values of the threshold cycle Ct in the number of copies per ml was performed on the basis of the Pfaffle method, adjusted for amplification efficiency. The obtained values (copies / ml) were converted into colony-forming units (CFU) / ml (10 ^ X CFU / ml, where X is the

degree). For further statistical analysis, the data were presented in the form of a decimal logarithm - lg / CFU / ml.

The list of identified microorganisms and their reference values are given in Table 1.

Table 1. Reference values of GM indicators, which were studied in the work.

№	GM indicators	Reference values
1	Total bacterial mass, CFU / ml	$10^{11} – 10^{13}$
2	*Lactobacillus spp.*, CFU / ml	$10^7 - 10^8$
3	*Bifidobacterium spp.*, CFU / ml	$10^9 - 10^{10}$
4	*Escherichia coli*, CFU / ml	$10^6 - 10^8$
5	*Bacteroides fragilis group*, CFU / ml	$10^9 - 10^{12}$
6	*Faecalibacterium prausnitzii*, CFU / ml	$10^8 - 10^{11}$
7	*Klebsiella pneumoniae*, CFU / ml	Not more than 10^4
8	*Klebsiella oxytoca*, CFU / ml	Not more than 10^4
9	*Candida spp.*, CFU / ml	Not more than 10^4
10	*Staphylococcus aureus*, CFU / ml	Not more than 10^4
11	*Escherichia coli enteropathogenic*, CFU / ml	Not more than 10^4
12	*Enterococcus spp.*, CFU / ml	Not more than 10^8
13	*Bacteroides thetaiotaomicron*, CFU / ml	Any quantity is allowed
14	*Clostridium difficile*, CFU / ml	Absent
15	*Clostridium perfringens*, CFU / ml	Absent
16	*Proteus spp.*, CFU / ml	Not more than 10^4
17	*Enterobacter spp. / Citrobacter spp.*, CFU / ml	Not more than 10^4
18	*Fusobacterium nucleatum*, CFU / ml	Absent
19	*Parvimonas micra*, CFU / ml	Absent
20	*Salmonella spp.*, CFU / ml	Absent
21	*Shigella spp.*, CFU / ml	Absent
22	*Akkermansia muciniphila*, CFU / ml	Any quantity is allowed up to 10^{11}
23	*Bacteroides fragilis group/ Faecalibacterium prausnitzii* ratio	0,01- 100

Note: CFU - colony-forming unit

The control group consisted of 20 healthy individuals (11 men and 9 women) aged 29 to 50 without cardiovascular and other chronic diseases.

Statistical analysis of the data was performed using standard methods using Microsoft Excel 17.0. The Kolmogorov – Smirnov test was used to assess the nature of the distribution as a whole from sample data. The results are given as the median (Me) and the interquartile range (25 and 75 percentiles). The significance of the differences was determined using the Mann – Whitney U test. The critical significance level for all tested statistical hypotheses is $p < 0.05$.

Results and discussions. As a result of the work, it was revealed that the overwhelming majority of GM indicators in the examined practically healthy individuals of the control group were within the framework of the reference values of the formal norm. There were only minor deviations from the reference values of the following GM indicators: total bacterial mass (increased in 5% of individuals in the control group), the amount of *Lactobacillus spp.* and *Bifidobacterium spp.* (reduced in 10% of individuals) and the number of *Escherichia coli* (reduced in 5% of individuals).

In patients with hypertension, significant differences were found in the number of individual indicators of GM in comparison with the reference values. On the one hand, the number of GM indicators in patients with hypertension was reduced in comparison with the reference values. In 100% of patients, there was a decrease in the number of *Lactobacillus spp.*, in 83% - *Bifidobacterium spp.*, in 17% - *Escherichia coli* and in 42% - *Faecalibacterium prausnitzii*. On the other hand, 17% of patients with AH had an increase in the total bacterial mass and the number of *Bacteroides fragilis* group, 8% - an increase in the number of *Enterobacter spp./Citrobacter spp.* Also, in 8% of hypertensive patients, an increase in the *Bacteroides fragilis* group / *Faecalibacterium prausnitzii* ratio was found in comparison with the reference values, which characterizes anaerobic intestinal imbalance.

Deviations in the number of *Klebsiella pneumoniae, Klebsiella oxytoca, Candida spp., Staphylococcus aureus, Escherichia coli enteropathogenic, Enterococcus spp., Bacteroides thetaiotaomicron, Clostridium difficile, Clostridium perfringens, Proteus spp., Fusobacterium nucleatum, Parvimonas micra, Salmonella spp. Shigella spp., Akkermansia muciniphila* from the reference values in patients with hypertension was not detected.

Further, we analyzed the peculiarities of the quantitative composition of GM by the absolute values of individual microorganisms in patients with AH in comparison with practically healthy individuals in the control group.

Due to the fact that such representatives of GM as *Klebsiella pneumoniae, Klebsiella oxytoca, Candida spp., Staphylococcus aureus, Escherichia coli enteropathogenic, Enterococcus spp., Clostridium difficile, Clostridium perfringens, Proteus spp., Fusobacterium nucleatum, Parvimonas micra, Salmonella spp., Shigella spp.* were not detected in patients and individuals of the control group, or were detected only in isolated cases (*Bacteroides thetaiotaomicron, Enterobacter spp./Citrobacter spp.*) for the analysis of absolute values, the following were selected: total bacterial mass, the number of *Lactobacillus spp., Bifidobacterium spp., Escherichia coli, Bifidobacterium spp., Escherichia coli, Bifidobacterium spp. fragilis group, Faecalibacterium prausnitzii, Akkermansia muciniphila* and the *Bacteroides fragilis* group / *Faecalibacterium prausnitzii* ratio (Table 2).

The results of the analysis indicate a significant decrease in the number of *Lactobacillus spp.* ($p < 0.05$), *Bifidobacterium spp.* ($p < 0.05$) *and Faecalibacterium prausnitzii* ($p < 0.05$) in GM in patients with hypertension compared with the control group. At the same time, the total bacterial mass and the number of *Escherichia coli, Bacteroides fragilis group, Akkermansia muciniphila,* the *Bacteroides fragilis group / Faecalibacterium prausnitzii* ratio in patients with AH and in the control, group did not differ significantly ($p > 0.05$).

When discussing the results obtained in the light of the problem of the pathogenesis of hypertension, it is necessary to refer to the literature data on the properties of those intestinal

Table 2. Quantitative characteristics of GM indicators in patients with AH and people in the control group (Me [25%; 75%]).

GM indicators	Patients with AH (n=36)	Control group (n=20)
Total bacterial mass, lg / CFU / ml	11,02 [10,10;11,92]	11,10 [10,45;11,60]
Lactobacillus spp., lg / CFU / ml	4,81[4,62;4,95] *	7,74 [7,39;7,91]
Bifidobacterium spp., lg / CFU / ml	8,12[7,54;8,73] *	9,65[9,39;9,74]
Escherichia coli, lg / CFU / ml	6,33 [5,24;7,03]	7,87[7,81;7,95]
Bacteroides fragilis group, lg / CFU / ml	10,22 [8,94;10,86]	10,85[9,90;11,30]
Faecalibacterium prausnitzii, lg / CFU / ml	8,87 [7,35;9,48] *	10,42[9,90;10,78]
Akkermansia muciniphila, lg / CFU / ml	8,61 [7,82;10,35]	9,30 [6,75;10,90]
Bacteroides fragilis group/Faecalibacterium prausnitzii ratio	65,54 [18,22;120,35]	25,02 [17,50;82,53]

Note: * - the level of statistical significance of differences between the indicators of GM in patients with AH and in the control group - p<0.05.

bacteria, the quantitative characteristics of which were most changed in the examined patients. First of all, the literature notes the important protective role of *Lactobacillus spp.* and *Bifidobacterium spp.* in maintaining normal morpho-functional characteristics of the colon: in maintaining the normal qualitative and quantitative composition of GM, in preventing overgrowth of pathogenic microorganisms and in ensuring the normal barrier function of the intestine [16,17]. Moreover, there is evidence that an increase in the permeability of the intestinal barrier and dysbiosis is associated with an increase in BP and atherogenic changes in experimental animals [17,18]. Also, in a number of studies, a negative correlation was found between the level of systolic BP and the number of *Lactobacillus spp.* and a decrease in BP in patients with hypertension after the use of *Lactobacillus spp.* as probiotics [17,19,20].

Of particular interest are the data obtained in our work regarding *Faecalibacterium prausnitzii*. The point is that this bacterium is one of the main producers of the SCFA butyrate, which shows pronounced anti-inflammatory and cardiovascular protective properties [6,9,12]. A number of studies have shown that butyrate is involved in the regulation of BP: butyrate penetrates the blood-brain barrier and affects the central mesanisms of BP regulation [21], butyrate deficiency leads to an increase in BP in spontaneously hypertensive rats [22], and a decrease in the amount of butyrate - producing bacteria in GM and butyrate production is associated with an increase in BP, both in spontaneously hypertensive rats and in humans (pregnant women) [23,24]. In addition, the above noted *Bifidobacterium spp.* also refer to bacteria that are involves in the formation of SCFAs, which further enhances their role in the regulation of BP [6,11].

Thus, the results obtained are generally consistent with the data of other authors on the decrease in the number of such representatives of GM, as *Lactobacillus spp., Bifidobacterium spp.* and *Faecalibacterium prausnitzii* [10,12,16]. At the same time, we did not find a number of changes in the composition of GM, in particular, an increase in the number of bacteria with which the excessive formation of LPSs and TMAO is associated, and which were detected in some works of other authors in patients with AH [3,6,12].

Conclusion.

In patients with AH (residents of Ukraine), significant disturbance of the quantitative characteristics of GM were established in comparison with practically healthy individuals: a significant decrease in the number of *Lactobacillus spp., Bifidobacterium spp.* and *Faecalibacterium prausnitzii*. Taking into account the available data on the involvement of *Lactobacillus spp., Bifidobacterium spp.* and *Faecalibacterium prausnitzii* not only in the maintenance of normal morpho-functional parameters of the colon, but also in the regulation of BP, a significant deficiency of these components of GM found in the work in patients with AH can play an important role in the pathogenesis of hypertension.

Conflicts of interest. authors have no conflict of interest to declare.

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SUMMARY

QUANTITATIVE CHARACTERISTICS OF GUT MICROBIOTA IN PATIENTS WITH ARTERIAL HYPERTENSION

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Aim. The aim of the work is to study the quantitative characteristics of gut microbiota (GM) in patients with arterial hypertension AH - residents of Ukraine in comparison with practically healthy individuals.

Materials and methods. 36 patients with AH stage II, 2-3 degrees against the background of normal body weight were examined. The control group consisted of 20 apparently healthy individuals. The examination included standard clinical, laboratory and instrumental methods. For determination of the quantitative composition of GM were used the method of polymerase chain reaction with hybridization-fluorescence detection of results in real time and the test system "COLONOFLOR-16 (biocenosis)" ("ALFALAB"). Statistical analysis of the results was carried out by standard methods using Microsoft Excel 17.0.

Results. The significant changes in GM quantitative characteristics were found in patients with AH (resident of Ukraine) in comparison with healthy individuals: a significant decrease in the number of *Lactobacillus spp., Bifidobacterium spp.* and *Faecalibacterium prausnitzii*.

Conclusions. The deficiency of *Lactobacillus spp., Bifidobacterium spp.* and *Faecalibacterium prausnitzii* in patients with AH - residents of Ukraine may indicate the important role of GM disorders in the pathogenesis of hypertension.

Key words: Arterial hypertension, gut microbiota.

РЕЗЮМЕ

КОЛИЧЕСТВЕННЫЕ ХАРАКТЕРИСТИКИ МИКРОБИОТЫ КИШЕЧНИКА У БОЛЬНЫХ АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

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Цель исследования - изучить количественные характеристики микробиоты кишечника (МК) у больных артериальной гипертензией (АГ) жителей Украины в сравнении с практически здоровыми лицами.

Материал и методы. Обследовано 36 больных АГ II стадии, 2–3 степени с нормальной массой тела. Контрольная группа состояла из 20 практически здоровых лиц. Обследование включало стандартные клинические, лабораторные и инструментальные методы. Для определения количественного состава МК использовались: метод полимеразной цепной реакции с гибридизационно-флуоресцентной детекцией результатов в режиме реального времени и тест система «КОЛОНОФЛОР-16 (биоценоз)» («АЛЬФАЛАБ»). Статистический анализ результатов проводили стандартными методами с использованием Microsoft Excel 17.0.

Результаты. Установлены существенные нарушения количественных характеристик МК у больных АГ (жителей Украины) в сравнении с практически здоровыми лицами: достоверное снижение количества *Lactobacillus spp., Bifidobacterium spp.* и *Faecalibacterium prausnitzii.*

Заключение. Выявленный у больных АГ - жителей Украины дефицит *Lactobacillus spp., Bifidobacterium spp.* и *Faecalibacterium prausnitzii* может свидетельсовать о важной роли нарушений МК в патогенезе гипертензии.

Ключевые слова: артериальная гипертензия, микробиота кишечника.