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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

THE ROLE OF INFECTIOUS PROCESSES IN THE OCCURRENCE OF CARDIOVASCULAR DISEASES AND OPTIMIZATION OF PREVENTIVE MEASURES

Specialty: 2414.01– Microbiology

Science field: Medicine

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GENERAL CHARACTERISTICS OF THE RESEARCH

The relevance and degree of completion of the topic. Myocarditis is a disease caused by inflammation of the heart muscle, most commonly resulting from an infectious process. However, it can also arise due to drug hypersensitivity, radiation, metabolic disorders, collagen diseases, sarcoidosis, Kawasaki disease, or excessive exposure to heat or chemicals[1].

Determining the prevalence of myocarditis in the general population is challenging, as many patients remain undiagnosed. However, it affects approximately 10.2 to 105.6 per 100,000 people worldwide, with an estimated annual incidence of around 1.8 million cases[2].

A Swedish study by Fu M. and associates indicated an increase in the incidence of myocarditis from 6.3 to 8.6 per 100,000 from 2000 to 2014[3]. Globally, myocarditis occurs in approximately 22 per 100,000 individuals annually[4]. Furthermore, autopsy studies reveal a detection frequency of 9%[5]. Myocarditis has been identified as the cause in 16–21% of sudden death cases and may account for lethal outcomes in up to 7% of young athletes[6].

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4. Ammirati, E.; Frigerio, M.; Adler, E.D. et al. Management of Acute Myocarditis and Chronic Inflammatory Cardiomyopathy: An Expert Consensus Document. Circ. Heart Fail. 2020, 13, e007405
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Studies have suggested that bacteria also play a role in the development of cardiovascular diseases[7]. This hypothesis is based on the production of chemical compounds such as trimethylamine-N-oxide (TMAO). Studies conducted on mice have shown that increased levels of TMAO contribute to cardiovascular diseases, including atherosclerotic lesions[8].

However, microorganisms can also produce TMAO in the organism. In 2013, it was confirmed that TMAO in the human body is generated by bacteria. Following the discovery of microbial production of TMAO, research began in both cardiology and microbiology to investigate the relationship between these metabolites and the development of cardiovascular diseases[9].

Myocarditis is an inflammatory disease of the myocardium characterized by broad etiological, clinical, and histopathological heterogeneity. It may occur as an isolated condition or as part of systemic infectious/immune/autoimmune disorders. The wide spectrum of myocarditis can be classified according to the predominant histopathological pattern, including lymphocytic, lymphohistiocytic, eosinophilic, neutrophilic forms, giant cell myocarditis, and myocarditis with granulomas. Different histopathological substrates typically reflect distinct etiologies and pathogenetic mechanisms, which may be critical for clinical decision-making. When present, active vasculitis complements the inflammatory spectrum. Unfortunately, the correlation between histopathological patterns, clinical presentation, and disease course in myocarditis remains unresolved due to limited biopsies at certain disease stages and the impossibility of obtaining serial samples.

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7. Novakovic M, Rout A, Kingsley T, et al. Role of gut microbiota in cardiovascular diseases. World J Cardiol. 2020;12(4):110-122.
8. 8.Ilyas A, Wijayasinghe YS, Khan I, et al. Implications of trimethylamine N-oxide (TMAO) and Betaine in Human Health: Beyond Being Osmoprotective Compounds. Front Mol Biosci. 2022;9:964624.
9. Liu Y, Dai M. Trimethylamine N-Oxide Generated by the Gut Microbiota Is Associated with Vascular Inflammation: New Insights into Atherosclerosis. Mediators Inflamm. 2020;2020:4634172.

Here we consider elements supporting etiology-based diagnostic investigation in myocarditis, emphasizing the importance of integrating pathological findings with clinical characteristics and data from multimodal imaging. Besides, we explore myocardial inflammation in genetic cardiomyopathies, its role in governing clinical variability, and the potential of transcriptomic and proteomic analyses for understanding these complex relationships[10].

Myocarditis is a common inflammatory heart disease where accurate diagnosis remains challenging due to highly variable symptoms and clinical presentation. Moreover, the clinical course can range from complete recovery to end-stage heart failure, and autopsy data indicate that myocarditis accounts for 5-20% of sudden deaths in young adults. Therefore, reliable tools for screening and risk stratification in myocarditis are needed. Cardiovascular magnetic resonance imaging has emerged as the diagnostic method of choice. The inflammatory and fibrotic changes caused by myocarditis lead to acute myocardial necrosis and/or chronic scarring/fibrosis, which are primarily characterized by subepicardial and/or intramural late gadolinium enhancement, often showing patchy distribution and typically located in the myocardium. A study conducted on more than 220 patients with biopsy-confirmed myocarditis proved that late gadolinium enhancement was the best independent predictor of all-cause mortality and cardiac death. In contrast, patients with negative late gadolinium enhancement had a better prognosis regardless of their clinical symptoms[11].

Myocarditis is a collection of clinical and morphological changes in the heart tissue (cardiomyocytes, conductive system cells, connective tissue structures, etc.) that is confirmed or determined in cases where infectious, toxic, or immune-mediated inflammatory changes in the myocardium are proven or strongly suspected. Although myocarditis was identified as an independent nosological entity more than 200 years ago, there are still many unanswered questions regarding its etiology, pathogenesis, diagnosis, and specific treatment.

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11. Mahrholdt H., S.Greulich Prognosis in Myocarditis // Journal of the american college of cardiology, 2017. 70 (16), p.1988-90

Today, there is no universally accepted classification of myocarditis. Its true prevalence is also unknown, as the clinical manifestations of this disease are nonspecific, and the gold standard diagnostic method (endomyocardial biopsy) is rarely performed. In some cases, myocarditis may resolve spontaneously without treatment, leaving no trace. However, in 30% of patients, left ventricular dysfunction and dilation develop. In such cases, the progression of myocarditis to inflammatory dilated cardiomyopathy is discussed, which worsens the patient's prognosis.

Research Purpose: To study the characteristics of cardiovascular system pathologies during various infections using clinical-instrumental and bacteriological examination methods.

Research Tasks:

1. Stratification of patients in the study groups based on age and severity, including those with and without cardiovascular diseases suffering from bacterial ENT infections, rheumatism, and respiratory viral infections.

2. Identification of the prevalence of various inflammatory gastrointestinal diseases in study groups consisting of patients with and without cardiovascular diseases suffering from bacterial ENT infections, rheumatism, and respiratory viral infections; investigation of potential associations between the studied infectious processes and gastrointestinal conditions and their complications.

3. Identification of various infectious processes, diseases, and pathologies diagnosed within the past month in the study groups.

4. Investigation of the antibiotic susceptibility of microorganisms detected in biological samples taken from patients with cardiovascular pathologies during various infections.

5. Examination of the presence of pathogenic microorganisms in nasopharyngeal swab samples obtained from groups of patients with and without cardiovascular disease who have recently had bacterial ENT infections or rheumatism.

Scientific novelty:

- For the first time in our country, determination of the relationship between the prevalence of virus- or bacteria-induced cardiovascular diseases (such as infectious myocarditis) and inflammatory-infectious complications.
- Study of various characteristics of pathogens causing inflammatory-infectious diseases in individuals with infection-related cardiovascular diseases and selective microbiological study of drugs against them.
- Investigation of the potential relationship between inflammatory-infectious processes identified in individuals with cardiovascular diseases and the pathologies of the cardiovascular system.

Practical significance:

1. Studying the characteristics of the relationship between detected cardiovascular diseases and various inflammatory-infectious conditions can enable more effective prevention by timely elimination of relevant inflammatory-infectious conditions before irreversible cardiovascular pathologies develop.
2. The use of selective antimicrobial agents against infectious factors that may cause cardiovascular diseases can facilitate the implementation of more effective treatment measures.

Main Provisions for Defense:

1. Since preventive, therapeutic, and rehabilitation measures for cardiovascular disorders and chronic heart diseases are still not fully effective, these conditions have a significant place in overall morbidity rates.
2. The high frequency of autonomic dysfunctions is noted in connection with various forms of somatic pathology, including pathological changes in the heart and blood vessels, which often result from the negative effects of certain infectious agents, particularly viral pathogens.
3. Among the etiological and pathogenetic risk factors for cardiovascular diseases, infectious diseases of bacterial, viral, and other origins, along with immune system disorders,

endocrine pathologies, and increasing environmental pollution, are of particular significance.

4. Studying the characteristics of the relationship between cardiovascular diseases and various inflammatory-infectious conditions can contribute to the prevention of cardiovascular diseases.

5. The reason for selecting specific age intervals in patients is to ensure the reliability of the results by allowing for the comparison of pathological, physiological, biological, and microbiological indicators obtained from patients of corresponding age groups.

Approbation. The results of the research were discussed at the following conferences: Materials of the international scientific-practical conference on the topic “Heydar Aliyev’s model of statehood in the modern era: realities and facts”, international scientific-practical conference dedicated to the 100th anniversary of the Azerbaijan Democratic Republic and the 95th anniversary of the birth of the National Leader Heydar Aliyev (Baku, May 8, 2018); Scientific-practical conference on Current Problems of Medicine (dedicated to the 100th anniversary of the Azerbaijan Democratic Republic) (Baku, 2018); Scientific dialogue: Questions of medicine. XIX international scientific-practical conference (Saint Petersburg, May 15, 2019).

The primary defense of the dissertation took place at an extended meeting held with the participation of the employees of the "Biology, Psychology and Pedagogical Subjects" department of Odlar Yurdu University (08.05.2024, protocol No. 08) and at a meeting of the Discussion Council of Azerbaijan Medical University, which conducts scientific seminars on the specialty 2414.01- "Microbiology" (23.12.24, protocol No. 6).

Publications. Eight scientific articles and theses have been published on the topic of the dissertation (5 articles, 4 theses). One speech was delivered. Of these, 4 articles and 2 theses were

published in local, 1 article and 2 theses were published in foreign press.

Structure and Volume of the Dissertation. The dissertation consists of 141 computer pages (213,996 characters) and includes an introduction (9,218 characters), a literature review (68,409 characters), research materials and methods (6,845 characters), results of the personal research (96,581 characters), a conclusion (30,898 characters), results (1,701 characters), practical recommendations (344 characters), and a bibliography. The dissertation is illustrated with 8 tables, 1 diagram, and 8 graphs. The bibliography includes 146 sources.

MATERIALS AND METHODS OF THE RESEARCH

The study included a total of 200 patients with cardiovascular diseases (main group), comprising 98 individuals with bacterial ENT diseases, 80 with rheumatism, and 22 with frequent respiratory viral infections. Besides, there were 125 patients without any cardiovascular diseases (control group), which included 55 with bacterial ENT diseases, 52 with rheumatism, and 18 with respiratory viral infections. This division aimed to analyze the age and weight classification of patients in the research groups, particularly those with infectious myocarditis associated with cardiac arrhythmias, characterized by subfebrile body temperature, increasing weakness, tachycardia, and shortness of breath.

In order to separate the patients in the study groups consisting of patients with and without cardiovascular diseases (most often **infectious myocarditis accompanied by cardiac arrhythmia** - subfebrile body temperature, increasing weakness, tachycardia, shortness of breath are observed), bacterial ENT diseases, rheumatism and respiratory viral infections, according to age and severity, a total of 200 patients with cardiovascular diseases (Main group), including 98 patients with bacterial ENT diseases, 80 patients with rheumatism and 22 patients with frequent respiratory viral infections, and a total of 125 patients without any cardiovascular diseases (Control group), including 55 patients with

bacterial ENT diseases, 52 patients with rheumatism and 18 patients with respiratory viral infections, were involved in the study. In this context, bacterial ENT disease refers to individuals who have been diagnosed with chronic bacterial tonsillitis, adenoiditis, or any other bacterial-origin disease confirmed through examinations and have contracted an illness at least twice in the past three months. Patients suffering from rheumatism include those who, in addition to exhibiting rheumatic symptoms, have also been found to have rheumatic factors in their blood tests. Those affected by respiratory viral infections refer to patients who have contracted respiratory tract infections caused by influenza, parainfluenza, or other virus-origin pathogens. In all research groups, patients were categorized into age groups of 17–29, 30–40, and over 40 years. These age intervals were selected due to their characteristic variations in the body's resistance to environmental and infectious factors. Furthermore, within each group, patients with bacterial ENT diseases, rheumatism, and respiratory viral infections were classified based on the severity of their respective conditions. To identify changes observed during ECG and echocardiography (ECHO) examinations, as well as to detect various cardiac issues, we conducted cardiological clinical assessments on patients. Clinical symptoms such as systolic murmurs, tachycardia, and bradycardia, along with changes in blood pressure, were evaluated. ECG parameters such as normal findings, reduced R-wave voltage, and repolarization disturbances, as well as ECHO findings including normal values, decreased ejection fraction, diastolic dysfunction, and other abnormalities, were also analyzed. In addition, a more in-depth analysis of various parameters during ECG was conducted. At the Department of Microbiology and Immunology of Azerbaijan Medical University, the biological samples collected were subjected to bacteriological diagnostics to study the effects of different types of antibiotics. This process aimed to identify the spectrum of various normal and pathogenic bacteria.

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and Immunology of Azerbaijan Medical University, the biological samples collected were subjected to bacteriological diagnostics to study the effects of different types of antibiotics. This process aimed to identify the spectrum of various normal and pathogenic bacteria.

The data obtained were processed using statistical methods in accordance with modern requirements. For group indicators, the mean values (M), their standard error (m), the minimum (min) and maximum (max) values of the ranges, as well as the frequency of occurrence of qualitative indicators within the groups, were determined.

For the initial assessment of differences between variation series, the parametric Student's t-test was used to evaluate the mean difference between selected indicators in paired dependent samples and to assess differences between proportions. Subsequently, to verify and refine the obtained results, non-parametric tests such as Wilcoxon (Mann-Whitney) U-test and Pearson's chi-square (χ^2) test for frequency analysis were applied.

RESULTS AND DISCUSSION

In our study, conducted to classify patients in the main and control groups based on age and disease severity, we analyzed individuals suffering from bacterial ENT diseases, rheumatism, and respiratory viral infections. Among patients with cardiovascular diseases and bacterial ENT diseases (n=98), 45 individuals belonged to the 17–29 age group, representing 45.9% of this research group. Meanwhile, in the research group consisting of patients with bacterial ENT diseases but without cardiovascular diseases (n=55), 27 individuals fell into the same age range, accounting for 49.1% of the respective group.

During the study, in the group consisting of patients with cardiovascular diseases and rheumatism (n=80), the age of 36 individuals ranged between 30 and 40 years, accounting for 45% of this group. However, in the research group consisting of patients diagnosed with rheumatism but without cardiovascular diseases

(n=52), 28 individuals belonged to the 17–29 age group, representing 53.8% of this group (Table 1).

As a result of the study, in the research group consisting of patients diagnosed with cardiovascular disease and frequently suffering from viral respiratory infections (n=22), 15 individuals, or 68.2% of the group, belonged to the 17–29 age range. Meanwhile, in the research group consisting of individuals without any serious heart disease but prone to respiratory viral infections (n=18), 9 individuals, or 50% of the group, fell within the 17–29 age range.

Table 1.

Age distribution of patients in research groups with and without cardiovascular diseases

Age groups	Patients with cardiovascular diseases (n=200)			Patients without cardiovascular diseases (n=125)		
	Patients with bacterial ENT disease, by number and percentage (n=98)	Patients with rheumatism, by number and percentage (n=80)	Patients with viral respiratory infections, by number and percentage (n=22)	Patients with bacterial ENT disease, by number and percentage (n=55)	Patients with rheumatism, by number and percentage (n=52)	Patients with viral respiratory infection, by number and percentage (n=18)
17-29	45 (45.9)	36 (45.0)	15 (68.2)	27 (49.1)	28 (53.8)	9 (50.0)
30-40	30 (30.6)	25 (31.3)	5 (22.7)	18 (32.7)	16 (30.8)	6 (33.3)
Over 40 years old	23 (23.5)	19 (23.8)	2 (9.1)	10 (18.2)	8 (15.4)	3 (16.7)

Patients who could be classified into the 30-40 age range by groups were identified and details of the study are given in the materials and methods section. In a study group of 98 patients with bacterial infections of the ENT organs and concomitant cardiovascular diseases, 30 individuals fell within the designated age range, accounting for 30.6% of the relevant group. Of the 55 patients with the same type of ENT disease as the corresponding study group but without cardiovascular disease, 18 had the appropriate age range, accounting for 32.7% of the individuals in the corresponding group.

In the research group consisting of individuals diagnosed with rheumatism and cardiovascular diseases (n=80), 25 patients were in the 30–40 age range, accounting for 31.3% of the respective group. However, in the research group composed of individuals suffering from rheumatism but without recorded cardiovascular diseases, 16 patients, or 30.8% of the group, were within the 30–40 age range.

In the research group consisting of patients diagnosed with viral respiratory infection along with cardiovascular diseases (n=22), 5 patients were in the 30–40 age range. Meanwhile, in the research group comprising patients with viral respiratory infection but without cardiovascular diseases (n=18), 6 patients were found to be within this age interval, accounting for 33.3% of the respective group. During the stage of identifying individuals over the age of 40 according to the previously mentioned groups, it was found that in the group where bacterial ENT diseases were accompanied by cardiovascular diseases (n=98), 23 patients fell into this age category, representing 23.5% of the group. At this stage, in the research group consisting of patients diagnosed with both rheumatism and cardiovascular diseases (n=80), 19 individuals were identified as being over the age of 40, accounting for 23.8% of the respective group. In the research group composed of patients with both cardiovascular diseases and viral respiratory infections (n=22), only 2 individuals were over 40 years old, representing 9.1% of that group.

In the 18-member group consisting of patients diagnosed only with viral respiratory infections, without cardiovascular

disease, 15 individuals suffered from moderate forms of the infection, accounting for 83.3% of the group. Meanwhile, in the 22-member group composed of patients with both viral respiratory infections and cardiovascular diseases, this indicator was also 15 individuals, representing 68.2% of the group.

In the research group consisting of patients with both bacterial ENT diseases and cardiovascular diseases (n=98), severe forms of ENT diseases were recorded in 22 individuals, accounting for 22.4% of the group. In contrast, in the group of patients suffering only from bacterial ENT diseases without cardiovascular diseases (n=55), severe forms were observed in 8 individuals, representing 14.5% of the respective group.

In the research group consisting of patients diagnosed with both rheumatism and cardiovascular diseases (n=80), severe forms of rheumatism were recorded in 3 individuals, accounting for 3.8% of the group. Meanwhile, in the research group composed of patients with rheumatism but without cardiovascular diseases (n=52), severe forms were observed in 4 individuals, representing 7.7% of the respective group.

In the research group consisting of patients suffering from viral respiratory infections without accompanying cardiovascular diseases (n=18), severe forms of the infection were observed in only 2 individuals, accounting for 11.1% of the group. In contrast, in the research group composed of patients with viral respiratory infections accompanied by cardiovascular diseases, severe forms of the infection were recorded in 7 individuals, representing 31.8% of the group.

Thus, during the study of the distribution of infectious diseases and the severity of rheumatism among research groups consisting of patients with and without cardiovascular diseases, bacterial ENT diseases, rheumatism, and viral respiratory infections, it was found that in the research group of patients with both bacterial ENT infections and cardiovascular diseases, a mild form of ENT disease occurred in 2 individuals, accounting for 2% of the respective group. Among the remaining 96 patients in this

group, 74 had moderate forms of infectious diseases, while severe forms were identified in 22 individuals.

When identifying the severity of infectious conditions in the research groups consisting of patients with ENT diseases, rheumatism, and viral respiratory infections, in the ENT patient group (n=55), a mild form of the bacterial disease was detected in 3 individuals, accounting for 5.5% of the respective group. In this group, moderate forms of bacterial ENT diseases were observed in 44 individuals, representing 80% of the group. The remaining 8 individuals, or 14.5% of the group, had severe forms of infectious ENT diseases.

When determining the distribution of severity levels of this systemic infectious disease caused by streptococci among patients in the research group consisting of individuals diagnosed only with rheumatism (n=52), a mild form of the disease was detected in 3 individuals, accounting for 5.8% of the respective group. At this stage, similar to the research group of patients suffering from bacterial ENT diseases, the majority of patients with rheumatism were those experiencing moderate rheumatic processes. When analyzing the distribution of acute phases of viral infections in the research group consisting of patients suffering from viral respiratory infections without any accompanying cardiovascular disease, we observed a trend similar to that seen in the research groups of patients with bacterial ENT diseases and rheumatism. Specifically, at this stage, the majority of cases were individuals prone to moderate respiratory viral infections.

In the research group consisting of patients suffering from viral respiratory infections concurrent with cardiovascular diseases (n=22), 5 individuals had been hospitalized with gastroenteritis complaints in the past six months and were subsequently diagnosed and treated for the condition. These individuals accounted for 22.7% of the respective group. However, in the research group consisting of patients diagnosed solely with viral respiratory infections, without concurrent cardiovascular disease (n=18), only 2 individuals were found to have sought medical attention and

received treatment for gastroenteritis. This accounted for 11.1% of the respective group.

An analysis of medical records revealed that in the research group consisting of patients diagnosed with both bacterial ENT infections and cardiovascular disorders (n=98), 33 individuals had been hospitalized for infectious gastrointestinal diseases, specifically enterocolitis, within the past six months. These cases accounted for 33.7% of the respective group. In contrast, in the research group composed of patients suffering from bacterial ENT infections without any diagnosed cardiovascular disease (n=55), 17 individuals had sought medical attention for enterocolitis—the most severe form of gastrointestinal infection—within the same period.

In the research groups consisting of patients suffering from combinations of bacterial ENT diseases, rheumatism, and viral respiratory infections, the examination of hospital visits related to gastroenterocolitis involving inflammation of the complex structures of the gastrointestinal system within the past six months, and the confirmation of the diagnosis through primary and additional examination methods, revealed the following: In the research group composed of patients with bacterial ENT infections and cardiovascular diseases (n=98), medical record analysis showed that 52 individuals had sought medical attention and undergone treatment related to gastroenterocolitis, accounting for 53.1% of the respective group. Unlike the combination of bacterial ENT diseases with cardiovascular diseases, in the research group consisting of 55 patients with bacterial ENT diseases without cardiovascular diseases, 33 individuals sought medical attention for gastroenterocolitis during the study period. During the identification of inflammatory diseases affecting various gastrointestinal structures or departments based on medical records, in the research groups consisting of different combinations of patients with cardiovascular diseases or pathologies, bacterial ENT infections, rheumatism, and viral respiratory infections, the following results were observed: The highest incidence of gastroenteritis-related medical visits was observed in the group where cardiovascular diseases were combined with rheumatism. For

enterocolitis, the highest visit rate was observed in the group of patients suffering from rheumatism. For gastroenterocolitis-related visits, the maximum visit rate was recorded in the group of patients where both cardiovascular diseases and bacterial ENT infections were present, and finally, for gastroenterocolitis-related visits, the highest rate was noted in the group of patients suffering only from bacterial ENT infections without cardiovascular diseases. Overall, when grouping the most common gastrointestinal diseases leading to medical visits in the research groups, the highest rate of hospital visits in the past six months was observed in the group where cardiovascular diseases and bacterial ENT infections were found together. The main reason for the visits was gastroenterocolitis, recorded for 52 individuals, accounting for 53.1% of the group. In the research group consisting of patients with both cardiovascular diseases and rheumatism, the most common reason for medical visits related to gastrointestinal issues was gastroenteritis, which was recorded for 39 individuals, accounting for 48.8% of the group. In the research group consisting of patients with a predisposition to viral respiratory infections along with cardiovascular diseases, the most common reason for medical visits was gastroenterocolitis, affecting 11 patients, or 50% of the group. The same gastrointestinal disease also showed the highest visit rate in the research group of individuals predisposed to bacterial ENT infections without cardiovascular diseases, with 33 patients, or 60% of the group, being affected. During the examinations, in the research group consisting of patients with confirmed rheumatism and no cardiovascular diseases, the most common gastrointestinal disease that led to hospital visits and required treatment in the past 6 months was gastroenteritis. It was recorded in the medical documents of 28 patients, accounting for 53.8% of the group. In this case, among the patients in the research group with a predisposition to viral respiratory infections without any cardiovascular diseases, the gastrointestinal disease with the highest incidence in the past 6 months was gastroenterocolitis, which was also observed in the research groups consisting of patients with bacterial LOR infections accompanied by cardiovascular diseases,

viral respiratory infections with cardiovascular diseases, and patients with a predisposition to bacterial LOR infections without cardiovascular diseases. In the group of 80 patients where both cardiovascular diseases and rheumatism were detected, acute pancreatitis as a complication of gastrointestinal diseases was recorded in 3 patients, which constitutes 3.8% of the research subjects in that group. However, in the group of 52 patients who had only rheumatism without any cardiovascular diseases and were diagnosed with various clinical and laboratory tests, no cases of acute pancreatitis as a complication during the treatment of gastrointestinal inflammatory processes were observed (Table 2).

Table 2.

Incidence of complications during treatment of inflammatory diseases of the gastrointestinal system in patients with and without cardiovascular diseases

Various complications occurring during the treatment of gastrointestinal problems	Patients with cardiovascular diseases (n=200)			Patients without cardiovascular diseases (n=125)		
	Patients with bacterial ENT disease, by number and percentage (n=98)	Patients with rheumatism, by number and percentage (n=80)	Patients with viral respiratory infections, by number and percentage (n=22)	Patients with bacterial ENT disease, by number and percentage (n=55)	Patients with rheumatism, by number and percentage (n=52)	Patients with viral respiratory infection, by number and percentage (n=18)
Acute pancreatitis	2 (2.0)	3 (3.8)	2 (9.1)	1 (1.8)	0	0
Anemia	4 (4.1)	5 (6.3)	1 (4.5)	5 (9.1)	5 (9.6)	1 (5.6)
Urinary tract infections	3 (3.1)	3 (3.8)	1 (4.5)	0	3 (5.8)	0

Patients who generally show complications	9 (9.2)	11 (13.8)	4 (18.2)	6 (10.9)	8 (15.4)	1 (5.6)

As a result of the study, in the group of 18 patients without cardiovascular diseases but with a documented predisposition to viral respiratory infections, no cases of gastrointestinal diseases progressing to acute pancreatitis were observed. However, in the group of 22 patients who had both cardiovascular diseases and a predisposition to viral respiratory infections, this condition was recorded in 2 individuals, accounting for 9.1% of the respective group.

When examining cases of anemia complications during the treatment of gastrointestinal diseases across different groups, laboratory tests confirmed that 4 patients in the group with a documented medical history of both cardiovascular diseases and a predisposition to bacterial ENT diseases (n=98) experienced this complication. This accounts for 4.1% of the respective group.

However, in the research group consisting of patients without cardiovascular diseases but with a documented high susceptibility to bacterial ENT infections (n=55), anemia was observed in 5 individuals, accounting for 9.1% of the group, based on the results of a complete blood count. Besides, in the group of patients suffering from both rheumatism and cardiovascular diseases (n=80), laboratory and clinical examinations confirmed the presence of rheumatism, and anemia was detected during the treatment of gastrointestinal diseases in 5 individuals, representing 6.3% of this group. In this case, in the group consisting of patients without any diagnosed form of cardiovascular disease but with rheumatism fully confirmed through examinations (n=52), anemia was observed in 5 individuals during the treatment of gastrointestinal conditions. This accounted for 9.6% of the total group.

In the research group consisting of patients with both cardiovascular diseases and an excessive predisposition to viral

respiratory infections (n=22), anemia complications were observed in 1 patient during the treatment of gastrointestinal diseases within the last six months. This accounted for 4.5% of the group. Similarly, in the group of patients without any diagnosed form of cardiovascular disease but with an abnormally high sensitivity to viral respiratory infections (n=18), anemia developed in 1 patient during the treatment of gastrointestinal diseases, representing 5.6% of the group. When determining the number of patients diagnosed with both gastrointestinal problems and urinary tract infections, 3 individuals in the research group consisting of patients with both cardiovascular diseases and a predisposition to bacterial ENT infections (n=98) had documented cases of these infections confirmed through clinical and laboratory examinations. This accounted for 3.1% of the group. However, in the research group consisting of patients with a predisposition only to bacterial ENT infections and no diagnosed form of cardiovascular disease (n=55), no cases of urinary tract infections were recorded. As a result of the retrospective study, in the research group consisting of individuals with both cardiovascular diseases and a predisposition to viral respiratory infections (n=22), one patient (4.5% of the group) experienced gastrointestinal issues in the past six months and developed a secondary urinary tract infection during treatment. However, in the research group consisting of 18 patients with a predisposition only to viral respiratory infections and no diagnosed cardiovascular diseases, no such cases were observed.

Overall, when examining various secondary complications arising during the treatment of gastrointestinal issues—previously analyzed in terms of their nature and distribution across groups—the group with both cardiovascular diseases and bacterial ENT infections (n=98) recorded complications in 9 patients, accounting for 9.2% of the study subjects in this group. In the group of patients suffering from bacterial ENT diseases without cardiovascular diseases (n=55), 6 patients experienced one or more of the complications mentioned above, accounting for 10.9% of the group. Besides, in the group consisting of individuals with both cardiovascular diseases and confirmed rheumatism (n=80), medical

records showed that 11 patients experienced various complications during antimicrobial treatment for gastrointestinal diseases, representing 13.8% of the group. In this stage of the study, in the group of patients suffering from rheumatism without cardiovascular diseases (n=52), 8 patients exhibited one of the complications mentioned above, accounting for 15.4% of the total group. During the relevant phase of the study, in the group of patients with both cardiovascular diseases and a tendency toward viral respiratory infections (n=22), 4 patients showed one of the mentioned complications, representing 18.2% of the study objects in this group. However, in the group of individuals with a tendency toward viral respiratory infections without cardiovascular diseases (n=18), only 1 patient, or 5.6% of the study subjects, exhibited various secondary complications.

Thus, during the treatment of gastrointestinal diseases, the most common complication observed was acute pancreatitis in the group of 22 patients with cardiovascular diseases and a tendency to viral respiratory infections, accounting for 9.1%. In this regard, the corresponding group of 80 patients, in which the presence of both cardiovascular diseases and confirmed rheumatism by laboratory tests was observed, showed a 3.8% occurrence. During this phase, no cases of acute pancreatitis were observed in the group consisting of individuals without cardiovascular diseases but with rheumatism, as well as in the group without cardiovascular diseases but prone to viral respiratory infections. When the secondary development of anemia during the treatment of gastrointestinal problems was examined, the maximum and minimum occurrence rates were 9.6% and 4.1%, respectively, observed in the group of patients with rheumatism without cardiovascular diseases (n=52) and in the group with cardiovascular diseases and bacterial LOR diseases (n=98). In the phase of the study covering the last month, where acute otitis cases were examined, in the group of patients with cardiovascular diseases and a predisposition to bacterial LOR infections, only 1 person was found to have acute inflammation of the middle ear, which constitutes 1% of that group. Similarly, in the group of patients without cardiovascular diseases but with a

predisposition to bacterial LOR infections, only 1 person was observed to have acute otitis, but this represents 1.8% of that group. During the relevant phase of the study, in the group of patients suffering from both cardiovascular diseases and rheumatism, no cases of acute otitis were found within the last month. However, in the group of patients with rheumatism but no cardiovascular diseases, 2 individuals were found to have acute otitis, constituting 3.8% of the total research subjects in that group. In the corresponding study period, neither the group of patients with both cardiovascular diseases and a predisposition to viral respiratory infections nor the group of patients without cardiovascular diseases but with a predisposition to viral respiratory infections, had any complaints related to acute otitis within the last month.

When we identified cases of patients being referred for treatment related to atopic dermatitis in the last month, in the group of patients with a combination of cardiovascular diseases and an excessive predisposition to bacterial ENT infections, 12 individuals were noted to have sought medical attention for the aforementioned dermatological problems. These individuals constitute 12.2% of the total research subjects in this group. At the same time, in the group of patients with sensitivity to bacterial ENT infections but without cardiovascular diseases, 7 individuals sought medical attention and received analogous treatment measures due to clinical manifestations of atopic dermatitis in the last month. These patients constitute 12.7% of the total contingent in this group. In the study conducted to observe changes during ECG and Echo-ECG tests and detect various heart problems, it was found that out of a total of 200 patients with cardiovascular diseases, 147 patients had systolic murmurs detected during auscultation, which accounts for 73.5% of the respective patient group. However, in the conditional group consisting of 125 patients who had bacterial ENT diseases, rheumatism, and viral respiratory infections without any cardiovascular issues, no patients with systolic murmurs were found during clinical examinations. The statistical significance between the groups was determined as $p=0.0001$ (Table 3).

During the study, in a group of 200 patients, consisting of those with a tendency to bacterial ENT diseases, rheumatism, and viral respiratory infections along with cardiovascular diseases, 72 patients were observed to have muffled heart sounds, which accounts for 36% of the total research subjects in the group. However, as in the case of identifying the presence of systolic murmurs, in a group of 125 patients with a tendency to bacterial ENT diseases, rheumatism, and viral respiratory infections without cardiovascular diseases, no patients were found to have muffled heart sounds. The statistical relationship between the groups during this period was p=0.0001.

During the study, in a group of patients with cardiovascular diseases who sought medical attention due to a bacterial ENT infection suspected to be of viral origin in the past month (n=98), 15 samples tested positive for parainfluenza viruses in nasal-pharyngeal swabs, accounting for 15.3% of the total cases in the group. In contrast, in a group of patients without cardiovascular diseases, who sought medical attention for a bacterial ENT infection within the past month (n=55), parainfluenza viruses were detected in 7 samples, representing 12.7% of the total cases in the group. However, in none of the groups—namely, the group of patients with cardiovascular diseases and concomitant rheumatism (n=80), the group of patients with cardiovascular diseases who had a viral respiratory infection in the past month (n=22), the group of patients without cardiovascular diseases but with rheumatism (n=52), and the group of patients without cardiovascular diseases who had a viral respiratory infection in the past month (n=18)—were adenovirus representatives detected in the nasal-pharyngeal swabs. Overall, in the group of patients with cardiovascular diseases who had a bacterial LOR infection in the past month (n=98), 19 individuals had various virus representatives detected in their nasal-pharyngeal samples, which accounts for 19.4% of the group. In the group of patients with both cardiovascular diseases and rheumatism (n=80), this indicator was 15 individuals, which accounts for 18.8% of the group. In the group of patients with cardiovascular diseases and who had a viral respiratory infection in

the past month (n=22), this indicator was 7 individuals, or 31.8% of the group. In the group of patients with no cardiovascular disease but who had a bacterial LOR infection in the past month (n=55), this indicator was 12 individuals, or 21.8% of the group. In the group of patients with no cardiovascular disease but with rheumatism (n=52), 11 individuals had the same indicator, representing 21.2% of the group. Finally, in the group of patients with no cardiovascular disease and who had a viral respiratory infection in the past month (n=18), 2 individuals were identified, representing 11.1% of the group.

In order to study the susceptibility of *Enterobacteriaceae* representatives to various antibiotics in biological samples taken from patients suffering from cardiovascular system pathologies during different infections, samples were collected from patients who sought treatment and sent to the microbiological laboratory of the same healthcare facility for analysis, where the susceptibility of Enterococcus species to antibiotics such as Cephalexin, Cefoxitin, Cefotaxime, Cefepime, Ampicillin, Amoxicillin/Clavulanic Acid, Ciprofloxacin, Ofloxacin, Azithromycin, Amikacin, Gentamicin, Imipenem, and Meropenem was determined using antibiotic "discs" in terms of the number of cases and percentages.

Enterobacteriaceae are facultative anaerobic or aerobic microorganisms that undergo enzymatic modification of carbohydrates, have an antigenic structure, and produce various toxins and other virulence factors.

Enterobacteriaceae are the most commonly encountered group of Gram-negative rods and are among the microorganisms that require cultivation in clinical laboratories. Together with *Streptococci* and *Staphylococci*, they form one of the most disease-causing bacterial families. The classification of the *Enterobacteriaceae* family is complex and rapidly evolving due to the development of new methods that measure evolutionary distances, such as nucleic acid hybridization and sequencing. Although more than 25 genera and up to 110 species have been identified within this family, research indicates that only 20–25 species hold clinical significance, while the rest are rarely

encountered. The *Enterobacteriaceae* family has the following characteristic features:

they are gram-negative rods, they are motile, possessing peritrichous flagella, though some species are non-motile. These microorganisms grow in peptone or meat broth without requiring sodium chloride or other additives. They are capable of growth on MacConkey agar and can colonize both aerobic and anaerobic environments as facultative anaerobes. Their enzymatic metabolism of glucose mainly results in gas formation. Being catalase-positive and oxidase-negative, these bacteria also reduce nitrate to nitrite. Their DNA composition ranges from 39% to 59% G+C content. Various biochemical methods are used to differentiate species within the *Enterobacteriaceae* family. Currently, ready-to-use test kits are available for the simultaneous detection of multiple species.

Enterobacteriaceae are short gram-negative rods. Their typical morphological characteristics are observed *in vitro* on solid nutrient media. However, these microorganisms exhibit morphological variations in clinical settings. The study found that in 33.3 ± 12.17% of the total samples, *Enterobacteriaceae* were sensitive to Azithromycin, in 60.0 ± 12.65% of the samples to Amoxicillin, in 26.7 ± 11.42% of the samples to Cefotaxime, in 28.4 ± 4.81% of the samples to another antibiotic, and in 20.0 ± 10.33% of the total samples to Gentamicin. No sensitivity to Macropen, Ceftriaxone, Ampicillin, or Amikacin was detected in the samples.

Motile strains of Proteus species possess not only the somatic O antigen but also the H antigen. Some strains share specific polysaccharides with rickettsiae and can undergo agglutination with the serum of patients suffering from rickettsial infections. Proteus strains exhibit a broad spectrum of antibiotic sensitivity. P. mirabilis is usually inhibited by penicillin. The most effective antibiotics for this group are aminoglycosides and cephalosporins. Enteric bacteria begin to colonize the intestinal tract a few days after birth and subsequently constitute the main part of the normal anaerobic microflora (facultative anaerobes). E. coli serves as the prototype. Enteric bacteria are detected in water or milk and are transmitted via fecal contamination from sources such as sewage. *Pseudomonads*

and *Acinetobacter* species are widely distributed in soil and water. *Pseudomonas aeruginosa* occasionally colonizes humans and is the primary human pathogen of this group. *P. aeruginosa* is both invasive and toxigenic, causing infections in individuals with abnormal immune systems and serving as a significant nosocomial pathogen. *Pseudomonads* are gram-negative, motile, aerobic rods that produce water-soluble pigments. *P. aeruginosa* is widely distributed in nature and can also be found in moist areas of hospitals. This species is a saprophyte and can colonize humans. However, it only causes disease in individuals with weakened immune systems due to various factors.

As a result of the study, sensitivity to Azithromycin was recorded in 40.0 ± 12.65% of the total samples. The sensitivity of the species in smears was detected in 5 samples to Amoxicillin, 4 samples to Cefotaxime, 10 samples to Oxacillin, 4 samples to Cephalexin, 9 samples to Amikacin, and 9 samples to Gentamicin, corresponding to 47.7±5.32%, 23.9±4.54%, 5.7±2.47%, 22.7±4.47%, 10.2±3.23%, and 51.1±5.33% of the total samples, respectively. However, no significant sensitivity of the *E. coli* species to Macropen, Ceftriaxone, or Ampicillin was recorded in any sample.

At the stage of the study where bacterial and unicellular fungal representatives such as *S. pyogenes, Staphylococcus spp., Escherichia coli, Klebsiella pneumoniae*, *H. influenzae*, and *Candida* spp. were identified in the nasal and throat swabs of patients from different groups, *S. pyogenes* was detected in 18 samples within the group of patients (n=80) who had both cardiovascular disease and rheumatism, accounting for 22.5% of the group. However, in the group consisting only of patients with rheumatism (n=52), this microorganism was found in only 3 nasal and throat swabs, making up 5.77% of that group.

As a result of the study, various representatives of the *Staphylococcus* genus were detected in 5 nasal and throat samples from the group of patients with both cardiovascular disease and rheumatism, accounting for 6.25% of the group. However, in the group consisting only of patients with rheumatism (n=52),

Staphylococcus representatives were identified in only one sample, making up 1.92% of the total cases in that group.

During the study, the presence of *E. coli* in nasal and throat swabs was recorded in 10 samples from the group of patients with both cardiovascular disease and rheumatism (n=80), making it the second most frequently detected species after *S. pyogenes* and accounting for 12.5% of the group. In contrast, in the group consisting only of patients with rheumatism (n=52), *E. coli* was found in only one sample, representing 1.92% of the total cases in that group. A similar trend was observed for *K. pneumoniae* in the same group, with only one sample testing positive. However, in the group of patients with both cardiovascular disease and rheumatism, *K. pneumoniae* was detected in seven nasal and throat swab samples, accounting for 8.75% of the total cases in that group.

As a result of the study, the presence of *H. influenzae* in nasal and throat swabs was detected in 3 samples within the group of patients with both cardiovascular disease and rheumatism (n=80), accounting for 3.75% of the group. In contrast, in the group consisting only of patients with rheumatism (n=52), *H. influenzae* was identified in just one sample, representing 1.92% of that group. When assessing the presence of *Candida* genus fungi in nasal and throat swabs, its representatives were observed in 2 cases among patients with the cardiovascular disease + rheumatism combination (n=80), constituting 2.5% of the group. Similarly, in the group of 52 patients with only rheumatism, *Candida* species were detected in only one nasal and throat sample, accounting for 1.92% of the group, following the same pattern observed for *Staphylococcus* species, *E. coli, K. pneumoniae,* and *H. influenzae*.

At the next stage of the study, an analysis was conducted on the occurrence of *S. aureus, K. pneumoniae, S. pyogenes, H. influenzae, E. coli,* and *Candida* genus unicellular fungi in nasal and throat swabs from groups of patients with and without cardiovascular disease, all of whom had experienced a bacterial ENT infection in the past month. As a result, in the group of patients without cardiovascular disease who had a bacterial ENT infection in the last month (n=55), *S. aureus* was detected in 8 nasal and throat swabs,

accounting for 14.5% of the cases in that group. Meanwhile, in the group of patients with cardiovascular disease who had received treatment for a bacterial ENT infection in the past month (n=98), *S. aureus* was identified in 20 nasal and throat swabs, making up 20.4% of the total cases in that group.

The presence of *K. pneumoniae* in nasal and throat swabs obtained from patients who had experienced a bacterial ENT infection in the past month but did not have cardiovascular disease was detected in 5 samples, accounting for 9.1% of the group. However, in the group of patients who had both cardiovascular disease and a bacterial ENT infection in the past month, this indicator was recorded in 13 cases, making up 13.3% of the total study subjects. As a result of the bacterial analysis of nasal and throat swabs obtained from patients in different groups, *S. pyogenes* was found in only 3 samples (5.5%) in the group consisting of patients who had experienced a bacterial ENT infection in the past month (n=55). However, in the group comprising patients with both cardiovascular disease and a bacterial ENT infection in the past month (n=98), the activity of this species was observed in 14 cases, accounting for 14.3% of the study subjects in that group (Table 3).

As a result of the study, the presence of *H. influenzae* in the group consisting only of patients who had experienced a bacterial ENT infection was detected in 5 samples, accounting for 9.1% of the group. However, in the group of patients who had both cardiovascular disease and a bacterial ENT infection in the past month (n=98), this species was identified in 18 nasal and throat swabs, making up 18.4% of that group. Although a significant difference was observed in the occurrence of *H. influenzae* between the groups, no notable difference was found in the detection of *E. coli* between them. In the group consisting of 55 patients who had experienced a bacterial ENT infection in the past month, *E. coli* activity was observed in 3 nasal and throat swabs, accounting for 5.5% of the group. Meanwhile, in the group of 98 patients with both cardiovascular disease and a bacterial ENT infection in the past month, *E. coli* was detected in 6 cases, representing 6.1% of the group. When assessing the occurrence of active forms of *Candida*

genus fungi in nasal and throat swabs, these fungi were identified in 2 samples from the group of patients who had experienced a bacterial ENT infection in the past month but did not have cardiovascular disease (n=55), accounting for 3.6% of the total cases in that group. However, in the group of patients who had both cardiovascular disease and a bacterial ENT infection in the past month (n=98), *Candida* species were detected in 8 samples, making up 8.2% of that group.

Before the implementation of treatment measures for myocarditis, *S. aureus* was detected in 4 nasal and throat swabs, accounting for 20% of the collected samples. However, after the treatment for myocarditis was administered, *S. aureus* was identified in only 2 swabs, representing 10% of the samples. When analyzing the presence of *K. pneumoniae* in nasal and throat swabs before and after myocarditis treatment, the microorganism was detected in 3 samples before treatment, making up 15.0% of the group. However, after the treatment measures were carried out, *K. pneumoniae* was found in only 1 swab, accounting for 5.0% of the group. Before the initiation of treatment measures for myocarditis, *E. coli* was detected in 3 nasal and throat swabs obtained from patients, accounting for 15.0% of the study subjects. After the administration of myocarditis treatment, the same microorganism was identified in 2 swabs, representing 10.0% of the cases. A similar trend was observed in the detection of *Candida* genus fungi in nasal and throat swabs. Before myocarditis treatment, *Candida* was found in 3 samples (15.0%), whereas after treatment, it was detected in 2 samples, accounting for 10.0% of the cases.

Table 3.

Occurrence of certain microorganisms in swab samples of patients with and without cardiovascular disease who had a bacterial ENT infection

Microorganisms	Bacterial ENT infection in the past month (n=55)	Bacterial ENT infection in the past month + Cardiovascular	p

			disease (n=98)		
	number	%	number	%	
St. Aureus	8	14.5	20	20.4	0.5138
Klebsiella pneumoniae	5	9.1	13	13.3	0.6026
Str. Pyogenes	3	5.5	14	14.3	0.1135
H.influenze	5	9.1	18	18.4	0.1591
Candida	2	3.6	8	8.2	0.3320
Escherichia coli	3	5.5	6	6.1	1.00

Note: p – Statistical significance of the difference between groups (Fisher's exact test). * - $p < 0.05$.

Before the initiation of myocarditis treatment, *H. influenzae* was detected in 2 nasal and throat swabs obtained from patients. However, after the implementation of cardiovascular disease treatment measures, this microorganism was found in only 1 swab, accounting for 5.0% of the patients. The most significant difference in prevalence before and after treatment was observed for *S. pyogenes*. Prior to the start of myocarditis treatment, this microorganism was detected in 5 samples. However, in the bacteriological examinations conducted after the treatment, *S. pyogenes* was found in only 1 swab, corresponding to 25% and 5% of the patients, respectively.

Since preventive, therapeutic, and rehabilitation measures for cardiovascular disorders and chronic heart diseases have not yet achieved full effectiveness, these conditions hold a significant place in the overall morbidity rate of the population. In recent years, epidemiological studies conducted among children and adolescents have shown a threefold increase in the number of individuals with cardiovascular pathologies. At the same time, several foreign authors have highlighted the association between various forms of somatic pathology—including pathological changes in the heart and blood vessels—and the high prevalence of autonomic disorders caused by the negative effects of certain infectious agents, particularly viral pathogens. Besides, some foreign authors have noted that certain infectious factors, including viruses, are associated with the development of various somatic diseases, including cardiovascular pathologies. When these factors persist in the body for a long time

against a background of immunological disorders, they negatively affect blood vessels and cardiomyocytes, ultimately leading to damage in heart tissues. According to numerous scientific studies, the specific and non-specific clinical manifestations of cardiovascular diseases continue to increase worldwide, particularly among young individuals. Among the etiological and pathogenetic risk factors for cardiovascular diseases, infectious diseases of bacterial, viral, and other origins, along with immune system disorders, endocrine pathologies, and increased environmental pollution, are particularly significant. Herpesviruses, Epstein-Barr virus, Coxsackie B virus, and others, when present in the blood at certain levels, are considered viral pathogens that may contribute to the development of cardiovascular diseases by exacerbating ventricular dysfunction and leading to myocarditis. Currently, there are studies in world literature suggesting that infectious myocarditis, developing in the context of SARS-CoV-2, the novel coronavirus infection, may play a role in the occurrence of myocardial infarction, coronary spasm, cardiomyopathy, and other cardiovascular pathologies or myocardial injury patterns. In this regard, it is essential to emphasize the particular relevance of both local and international research studies dedicated to the investigation of possible viral-induced myocardial pathologies. Furthermore, the primary objective of some of these studies has been to determine the mechanisms of the negative effects of coronavirus infection on myocardial cells, as well as to investigate the possible interactions and impacts between the infectious process and heart diseases or pathologies. Furthermore, these studies have aimed to develop an optimal scheme for preventive and therapeutic measures. In cases of mild cardiac arrhythmias, certain positive dynamics observed in examined patients allowed for the differentiation of less clinically significant functional disorders, such as tachycardia, bradycardia, and pacemaker migration.

CONCLUSIONS

1. In the study group (n=22), which included patients suffering from both infectious myocarditis accompanied by cardiac arrhythmia and infections of viral origin, the distribution of patients experiencing mild, moderate, and severe forms of the viral infection process was determined. At this stage, no cases of the mild form were identified. However, 15 patients (68.2%) were recorded with the moderate form, while 7 patients (31.8%) had the severe form, according to the sequential classification within the respective group [5,2].
2. When we examined the diagnosis of gastroenteritis and the implementation of appropriate treatment measures in groups of patients suffering from rheumatism with and without cardiovascular diseases, it was found that, in the research group consisting of patients with the combination of cardiovascular diseases and rheumatism (n=80), 39 individuals had complaints related to inflammatory processes of the gastrointestinal tract. These individuals accounted for 48.8% of the respective group. In contrast, in the research group consisting only of patients suffering from rheumatism (n=52), 28 individuals were diagnosed with gastrointestinal disease, representing 53.8% of the respective group [9,8].
3. At the relevant stage of the study, in the group consisting of patients with both cardiovascular diseases and rheumatism (n=80), cases of infection caused by astrovirus representatives were observed in 2 individuals over the past month, accounting for 2.5% of the respective research group [4,3].
4. The broadest-spectrum antibiotics that were effective to varying degrees against all *P. aeruginosa* and *Enterobacteriaceae* microorganisms were Cefepime, Imipenem, and Meropenem. Regarding resistance, 60.0 ± 12.65% of the total samples exhibited resistance to Amoxicillin, 20.0 ± 10.33% showed resistance to Gentamicin, and the highest resistance was recorded against Ampicillin, which is 73.3 ± 11.42% of the samples [1].
5. In the group consisting of 52 patients suffering only from rheumatism, without cardiovascular disease, species of the

Staphylococcus genus, *E. coli*, *K. pneumoniae*, and *H. influenzae* were identified. Besides, representatives of *Candida* were observed in only one nasopharyngeal sample, accounting for 1.92% of this group [1,7].

PRACTICAL RECOMMENDATIONS

Studying the characteristics of the relationship between cardiovascular diseases and various inflammatory-infectious conditions allows for the use of selective antimicrobial agents against infectious factors that may cause cardiovascular pathologies. Additionally, by eliminating the respective inflammatory-infectious conditions, effective prevention of cardiovascular diseases can be ensured.

By studying pathogenic microorganisms that play a role in the occurrence of cardiovascular pathologies of inflammatory-infectious origin, it is possible to ensure the timely detection and elimination of relevant pathological conditions.

After the widespread use of antibiotics, a real increase in antibiotic resistance is observed. To counter this, a strategy that addresses the spread of resistance to antibiotics should be followed.

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