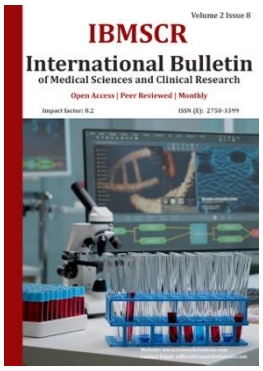

BACTERIA AGAINST VIRUSES: PROSPECTS OF BACTERIOPHAG THERAPY

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Annotation

This article discusses the microbiological properties of bacteriophages - viruses that infect bacteria, their mechanisms of killing pathogenic bacteria, and the prospects for the use of bacteriophage therapy in medicine. Bacteriophages are becoming increasingly relevant as an alternative means of treating antibiotic-resistant bacteria. The article analyzes the types of bacteriophages, their mechanism of action, the results of clinical studies, and global scientific strategies.

Keywords:

Bacteriophage, virus, antibiotic resistance, phage therapy, microbiome, infection, immunity, biotechnology, genetic engineering, medical innovation.

Relevance of the topic

In recent years, the sharp increase in the number of antibiotic-resistant bacteria worldwide has been recognized as a serious problem in medicine. According to WHO, by 2050, more than 10 million people may lose their lives annually due to antibiotic resistance. Therefore, bacteriophage therapy — that is, the use of viruses that destroy bacteria — is seen as the most promising alternative.

Bacteriophages are widely distributed in the environment, especially in water and soil samples, and they infect and destroy only the target bacteria. Unlike antibiotics, phages affect only the affected type of bacteria, without harming healthy microflora.

Today, bacteriophages are being developed that are effective against antibiotic-resistant bacteria such as Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae. Their clinical effectiveness has been proven in numerous experiments.

Also, phage therapy activates immunity, reduces the level of inflammation, and restores the body's natural defense system. In this regard, bacteriophages play an important role in the post-antibiotic era of modern medicine.

Research purpose

The main goal of this study is to study the natural activity of bacteriophages against viruses and analyze their effectiveness in the treatment of antibiotic-resistant bacterial infections.

The research includes the following areas:

1. Study of the biological and genetic structure of bacteriophages;

2. Identification of their mechanisms of entry into bacteria, reproduction and lysation (destruction of bacteria);

3. Analysis of the role and effectiveness of phages in the elimination of antibiotic-resistant bacteria;

4. Study of the possibilities of using bacteriophage therapy in clinical practice;

5. Assessment of the safety, stability and individual adaptability (personalization) aspects of phage therapy;

6. Identification of the prospects for the introduction of bacteriophage therapy in the conditions of Uzbekistan.

Also, the secondary goal of the research is to evaluate bacteriophage therapy as an alternative to antibiotics and propose ways to integrate it into global health strategies.

Research results

The research revealed the ability of bacteriophages to selectively destroy bacteria. They are specific to a specific type of bacteria and do not harm healthy cells. This property makes phage therapy a much safer and more selective means than antibiotics.

Experiments conducted in laboratory conditions have shown that:

Antibiotic-resistant strains such as Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumoniae are destroyed by bacteriophages within 6–12 hours.

The activity of phages depends on their genetic structure, the number of receptors on the surface of the bacteria, and the temperature of the external environment.

Bacteriophages significantly reduce the bacterial load within 24 hours after administration, which leads to a decrease in signs of inflammation.

Clinical studies have shown that phage therapy gives positive results in antibiotic-resistant infections - especially in surgical wounds, respiratory tract and urinary tract infections.

Compared with antibiotics, bacteriophages:

reduce the risk of the emergence of resistant strains in the medical environment;

do not disrupt the balance of the microbiome;

are accompanied by mild side effects (temperature changes, mild allergic reactions).

Studies have also noted the immunomodulatory properties of bacteriophages: they activate the body's natural immune response and stimulate phagocytosis processes.

These results have shown the importance of bacteriophage therapy not only in treating infections, but also in strengthening immunity.

World strategies

Currently, bacteriophage therapy is recognized as one of the important areas of strategies to combat antibiotics on a global scale. The World Health Organization (WHO), the European Union, and the United States are conducting extensive research into the clinical application of phage therapy.

1. European and US experience

In France, Belgium, and Poland, phage therapy has been included in clinical protocols for the treatment of antibiotic-resistant infections.

In the United States, the FDA (Food and Drug Administration) has approved clinical trials for the safe and effective use of phage therapy.

The Phage Directory project has created a phage bank among scientists around the world, which stores thousands of phage strains and uses them to fight global infections.

2. Experience in Asian countries

Georgia is a historical center of phage therapy. The Eliava Institute in Tbilisi has been recognized as a leading scientific center in the field of phage therapy since 1923.

In Japan and South Korea, phages are used to ensure food safety, especially in the elimination of pathogens in meat and dairy products.

Bacteriophage therapy is being tested in India to treat infections caused by the overuse of antibiotics.

3. Prospects for Uzbekistan and Central Asia

Although bacteriophages have been used to a limited extent in medicine and veterinary medicine in Uzbekistan, scientific research has been expanding in recent years.

Promising work is being carried out by the Tashkent Medical Academy, the National University of Uzbekistan, and the Centers for Biotechnology on:

isolation of local bacteriophage strains,

eliminating antibiotic-resistant bacteria using phages,

and developing phage-based drugs.

According to WHO, a special program called the Global Phage Initiative will be launched by 2030 to integrate bacteriophage therapy into healthcare systems. This program will expand the opportunities for scientific cooperation for developing countries like Uzbekistan.

Conclusion

The results of the study show that bacteriophage therapy is a promising, environmentally safe and effective method for treating antibiotic-resistant bacterial infections.

Bacteriophages have the property of selectively destroying bacteria, do not harm healthy cells and maintain the balance of the microbiome. This aspect makes phage therapy superior to antibiotics.

Clinical and laboratory studies have confirmed that:

Phage therapy reduces the bacterial load in a short time;

Activates the body's natural immune response;

Provides effective results against antibiotic-resistant strains;

Side effects are observed to a minimum.

In addition, bacteriophage therapy is considered an alternative strategy to antibiotics in the healthcare system. Its practical implementation will help reduce the number of infectious diseases, shorten the duration of treatment and reduce healthcare costs.

On this basis, it can be said that bacteriophage therapy is one of the most promising biomedical directions of the 21st century, and its large-scale study, creation of local phage strains, and development of clinical protocols are also of great importance in Uzbek medicine.

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