BACTERIA RESISTANCE TO BETA-LACTAM ANTIBIOTICS

Vasilenko S.V.
National Aviation University, Kyiv
Scientific adviser – Glushko Ju.M., Cand. Sc.(Agriculture)

Increasing antibiotic resistance of microorganisms is one of the urgent and unresolved problems in the fight against pathogenic microorganisms. Antibiotic resistance of microorganisms can be true and acquired. True resistance is characterized by the absence of the antibiotic action of the target in microorganisms or the inaccessibility of the target due to the primary low permeability or enzymatic inactivation. Acquired resistance it is the property of individual bacterial strains to maintain viability at those concentrations of antibiotics that suppress the bulk of the microbial population. The formation of resistance in all cases is due to genetics - the acquisition of new genetic information or a change in the level of expression of its own genes.

The most common cause of acquired resistance is the widespread use of a particular antibiotic, and the consequence is that previously sensitive strains become resistant. Beta-lactam antibiotics - penicillins, cephalosporins have been used for the longest time in clinical practice, so the problem of resistance to them is the most serious. Let's consider the most common reasons of antibiotic resistance development: unreasonable appointment of antibacterial drugs (ABD), mistakes in choosing the ABD, errors in the choice of the ABP dosing mode, errors associated with the duration of antibiotic therapy.

The genetic apparatus of bacteria is a single chromosome and plasmids including extremely mobile DNA molecules. It is these genes present in them that allow bacteria to survive in extreme conditions. Many of them, including genes for antibiotic resistance, being transposons, easily move from plasmid to plasmid or chromosome, which ensures their rapid spread within populations, species. During its existence, bacteria have developed natural and acquired resistance to antibiotics. Natural resistance is encoded in chromosomal genes. Acquired resistance is caused by spontaneous mutations.

Let's consider basic biochemical mechanisms of antibacterial resistance (ABR) there are: modification of the target of the action of the ABR, inactivation of ABR, active removal of ABR from the microbial cell, violation of the permeability of the external structures of the microbial cell.

The most common mechanism of antibiotic resistance is the enzymatic degradation of the antibiotic. Enzymes that destroy beta-lactam antibiotics are called beta-lactamases. It should be emphasized that strains producing beta-lactamases were found among both gram-positive and gram-negative microorganisms, including anaerobic ones [1].

There are such modes of transmission such as: transformation – the DNA of a dead antibiotic-resistant bacterium is captured from the environment by an antibiotic-sensitive cell; Transduction: random capture of bacterial DNA by a bacteriophage particle. Then the phage particle transfers the bacterial DNA to the next cell, which it infects; Conjugation,

which is the physical contact of two bacteria, during which DNA is transferred from the donor cell to the recipient cell [2].

Beta-lactam antibiotics are a group of antibiotics that are united by the presence of a β-lactam ring in the structure. Beta-lactams include subgroups of penicillins, cephalosporins, carbapenems, and monobactams. The mechanism of action of all β-lactams is violation of the synthesis of the bacterial cell wall. Penicillins, cephalosporins and monobactams are sensitive to the hydrolyzing action of special enzymes - β-lactamases, produced by a number of bacteria. Carbapenemsare characterized by a significantly higher resistance to β-lactamases. According to the number of drugs used in the clinic, this is the most numerous group among all antibacterial agents. Their diversity is explained by the desire to obtain new compounds with a wider spectrum of antibacterial activity, improved pharmacokinetic characteristics and resistance to constantly emerging new mechanisms of resistance of microorganisms.

Features of beta-lactamases. These enzymes are the main factor in the resistance to many beta-lactam antibiotics in most gram-negative bacteria. Producers of beta-lactamases capable of inactivating beta-lactam antibiotics are Escherichia, Proteus, Klebsiella. The formation of beta-lactamases by bacteria precludes the use of these antibiotics to treat infections.

Most bacterial strains are capable of producing several types of β-lactamases. There are several options for solving the problem of β-lactamase resistance: search for new β-lactam antibiotics, which are not subject to hydrolysis by β-lactamases; synthesis of beta-lactamase-resistant antibiotics. Examples are oxacillin, cefazolin, cephalosporins of III – IV generations and carbapenems, which are active against beta-lactamase-producing strains of most current pathogens; the use of combinations of antibiotics with beta-lactamase inhibitors.

Conclusion: thus, as we can see the problem of antibiotic resistance is extremely relevant in modern medicine all over the world. And we can solve this problem only in the way that each medical worker, prescribing antibiotics, should clearly be aware of the full measure of responsibility and strive for the optimal solution of these problems.

References

1.Pulok K. Mukherjee. Quality Control and Evaluation of Herbal Drugs: Evaluating Natural Products and Traditional Medicine. Elsevier, 2019. 762 p.

2.Kumar A., Schweizer H. Bacterial resistance to antibiotics: Active efflux and reduced uptake. *Adv. Drug Deliv. Rev.* 2005. Vol. 57. P. 513.

3.Antimicrobial Resistance: Tackling a Crisis for the Future Health and Wealth of Nations. Chaired by Jim O'Neill. London: Review on Antimicrobial Resistance. 2014. 16 p.

4. Thomas C. M., Nielsen K.M. Mechanisms of, and barriers to, horizontal gene transfer between bacteria. *Nat. Rev. Microbiol.* 2005. Vol. 3. P. 711–21.