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Editorial

Briefly About Bacterial Biofilms

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It is known that more than 99% of bacteria exist in natural ecosystems not as free-floating cells, but as biofilms attached to the substrate [1]. According to a number of researchers, the planktonic form can be considered only as a way of moving a microbial cell from one surface to another, that is, a short-term state in the life of bacteria [2].

The fact that bacteria form complex, constantly changing heterogeneous communities has been known for a long time, but was first described, according to various sources, in 1990s [1].

Pathogenic, opportunistic and non-pathogenic microorganisms, as well as their associations, are capable of forming biofilms in the human body. According to various data, from 60-65 to 80% of all microbial infections are correlated with the formation of a biofilm. These diseases include chronic urinary tract infections (*E. coli* and others), middle ear infections (*H. influenzae*), cystic fibrosis, fibrocystic pneumonia (*P. aeruginosa*), infective endocarditis, prosthetic valve infections, catheter-associated bloodstream infections and dental problems (caries, periodontitis, gingivitis) [3].

It has been shown that both Gram-positive (*Enterococcus* spp., *Staphylococcus* spp., *Streptococcus viridans*) and Gram-negative (*E. coli*, *K.pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter* spp., etc.) bacteria can form biofilms.

The key structural component of biofilms is the extracellular polymeric substance (matrix), while the bacteria themselves make up only 5–35% of the mass of biofilms. The matrix is a mixture of components such as lipopolysaccharides, glycoproteins, proteoglycans, nucleic acids and other substances similar in composition to bacterial cell walls [2].

Existence in the form of a biofilm gives microorganisms a number of advantages, the main of which is increased resistance to various adverse effects, resistance to antibiotics, disinfectants and effectors (humoral and cellular) of the human immune system. This very quickly leads to the formation and selection of resistant microorganisms. It is known that neutrophils and macrophages secrete reactive oxygen species and proteases, which are designed to promote the eradication of pathogens from the wound. But with their excessive attraction to the inflammatory locus, blocking the activity of polymorphonuclear leukocytes and ineffective immune response, there is an increase in damage to the tissues surrounding the biofilm due to a local increase in the concentration of biologically active substances, which occurs, for example, in chronic wound healing [4].

Such a situation can play a positive role for the biofilm itself, since its elimination is not always successful, and the accumulation of exudate caused by its presence can be used by sessile bacteria to feed and develop the consortium.

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As the population of bacteria increases and reaches a certain level, the transfer of information between individuals of bacteria belonging to the same and different species, genera, and even families begins. This process of exchanging information within a biofilm is called Quorum sensing (QS).

QS is a process of collective regulation by coordinating the expression of certain genes, mediating the specific behavior of cells and the synthesis of substances [5]. Antibiotic-resistant bacteria are able not only to secrete protective enzymes or proteins that can protect neighboring antibiotic-sensitive bacteria in the biofilm, but also to transfer genes responsible for antibiotic resistance to other, even unrelated bacteria.

Ways to overcome antibiotic resistance in biofilm

- Prevent adhesion
- Prevent the transition to biofilm formation and growth suppression (inhibitors of signal synthesis, inhibitors of signal propagation)
- Destruction of the formed biofilm (inhibitors of signal reception) [6].

It becomes obvious that modern ideas about the role of biofilm bacteria in human infectious pathology suggest a change in approaches to the treatment of diseases associated with biofilms, since traditional antibiotic therapy does not solve this problem.

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