1. Introduction

Infectious complications in surgery, despite the achievements of pharmacotherapy in antibiotic prophylaxis, continue to occur with the use of implants. In Ukraine, patients after endoprosthetics of large joints, patients with cancer prostheses, the prognosis after septic complications is not always favorable, treatment protocols require large material and time costs [1, 2]. The first stage in the development of an infectious complication is the formation of microbial films [3]. Since bacterial adhesion is one of the first steps in the formation of a biofilm, the creation of conditions that impede the attachment of cells to the surface can significantly slow down or completely impede its formation. A decrease in the adhesion of microorganisms on the surface of materials can be achieved due to functional polymer coatings [4, 5]. Coatings with silver content [6, 7] and biocomposite coatings with metal oxides have antimicrobial properties [8]. Recently, there have been works on the use of medicine of titanium implants with an oxidized surface in anatase [9, 10]. It is proposed to use this method of surface transformation of the anatase titanium alloy, which contains silicon dioxide crystals (patent for invention u201902729).

Aim: to evaluate the effectiveness of preventing the formation of microbial biofilms on the surfaces of implants made of titanium alloys VT5-1, VT6 with a transformed surface into anatase.

2. Materials and methods

For the anatase-converted surface of titanium alloys, the ability to prevent the formation of microbial biofilms of Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa is evaluated.

The study was carried out in the bacteriological laboratory of the Severodonetsk multidisciplinary city hospital from January 2019 to September 2019. The ability to prevent the formation of microbial biofilms of Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa was evaluated. The static cell adhesion method and the disc diffusion method were used. The surface of the plates was examined on a X5 6220 UCMJS05100KPA microscope. The intensity of the formation of microbial biofilms on the plates was evaluated visually by the four-cross system.

Results. On all coatings with anatase, in comparison with unmodified plates, the intensity of initial adhesion and the number of bacteria fixed on the surface of the colonies markedly decreased. On surfaces with silica crystals, biofilm formation was minimal. The altered surface of titanium alloys VT5-1 and VT6 anatase and anatase with silicon dioxide crystals does not inhibit microflora growth.

Conclusions. The transformed surface of titanium implants into anatase and anatase with silicon dioxide crystals prevents the fixation of biofilms of microbial associations.

Keywords: antimicrobial coatings, titanium implant, anatase.

RESEARCH OF ANTIMICROBIAL PROPERTIES OF THE SURFACE OF THE TITANIUM ALLOYS VT5-1 AND VT6 CONVERTED TO ANATASE TO PREVENT BACTERIAL ADHESION

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After autoclaving on plates with an anatase-changed surface with crystals of silicon dioxide, traces of biofilms are not found in all test tubes.

The results show that on all coatings with anatase, in comparison with unchanged plates, the intensity of initial adhesion and the number of bacteria fixed on the surface of colonies markedly decreased (Table 1). On the surfaces of anatase with crystals of silicon dioxide, the formation of biofilms is minimal.

<table>
<thead>
<tr>
<th>Implant material</th>
<th>St. Aureus</th>
<th>Esh.coli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium plate VT5-1, VT-6</td>
<td>++++</td>
<td>++++</td>
</tr>
<tr>
<td>VT5, VT-6 + TiO$_2$ titanium plate</td>
<td>+/- – –</td>
<td>++/– –</td>
</tr>
<tr>
<td>Titanium plate VT5-1, VT-6 + TiO$_2$ + SiO$_2$</td>
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</tbody>
</table>

In the second series, in Petri dishes with MT5-1 and MT6 plates, the colonies of cultures of St.aureus and Ps.aeruginosa touches the edges of the plates by the first day, and by the third day they begin to grow around the plates with tight contact with the edge of the implants (Fig. 1). Colonies of E. coli touched the plates by the first day, 10–20 mm around the plates by the third day.

Fig. 1. The third day after seeding, microbial colonies are fixed on titanium implants after contamination

References


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