that were grown up under the control conditions and exposed to consecutive impact of low positive temperature and UV-impact show a significant decrease in their functional activity.

References

1. Ali-zadeh G.I. Resistance of Dunaliella cells population to chronic UV-light impact under a low-temperature stress // Works of Azerbaijan botanist society. – 2010. – Vol. 1. – P. 321–325.

2. Borisova T.A., Bugadge S.M., Meshkova N.V., Vlasov P.V. Heat shock increases plants resisitance to UV-light irradiation. 1. Growth, development, and water-provision of tissue // Plants physiology. – 2001. – Vol. 48, №4. – P. 589–595.

3. Vendjik Y.V., Frolova S.A., Koteyeva N.K., Miroslavov E.A., Titov A.F. Structural-functional peculiarities of Triticum aestivum L. plants at primary period of cold adaptation // Botanical magazine. – 2008. – Vol. 93, №9. – P. 39–49.

4. Zykova V.V., Kolesnichenko A.V., Voynikov V.K. Active oxygen forms participations in mitochondrion reaction of plants to low-temperature stress // Plants physiology. – 2002. – Vol. 49, №2. – P. 302–310.

5. Raduk M.S., Domanskaya I.N., Sherbakova R.A., Shalygo N.V. Low temperature impact on low-molecural antioxidants contant and activity of antioxidant ferments of green barley leaves // Plants physiology. – 2009. – Vol. 56, №2. – P. 193–199.

6. Hodges D.M., Andrews Ch.J., Johnson D.A., Hamilton R.J. Antioxidant Compound Responses to Chilling Stress in Diferentinlly sensitive Inbred Maize Lines // Physiol. Plant. – 1996. – Vol. 98. – P. 685–692.

The work is submitted to the International Scientific Conference «Modern high technologies», Egypt, February 20-27, 2011, came to the editorial office 02.12.2010.

INFLUENCE OF SURFACE MODIFICATION OF ORTOPEDIC IMPLANTS BY NANOCOMPOSITE CARBON NITRIDE ON THEIR PROPERTIES

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The research task of this work was to study in vivo the effect of porous titanium surface modification by nanocomposite carbon nitride films on osteointegration properties of implants.

Materials and methods

Porous titanium implants with porosity $\theta = 40\,\%$ were made from granules of titanium sponge. The system of randomly distributed interconnected pores includes microscale pores of 2–5 μm and macrochannels (100–400) μm. The proportion of pores communicating to the surface accounted for ~75 % of the total number of pores. Diamond-like carbon nitride film (20–50) nm thick was deposited by the method of pulsed arc sputtering of graphite in nitrogen atmosphere. Porous titanium (PTi) and porous titanium with $CN_{0,25}$ film (PTi($CN_{0,25}$)) implants were saturated by the adherent fraction of autologous bone marrow extracted from the wing of iliac bone. The experiment was performed on 18 adult White giant rabbits of herd breeding, weighing 4–5 kg. The implants were implanted in rabbit right tibia and femoral condyles. Histological examination of bone tissue formed inside of porous was performed after removing titanium matrix in a solution of hydrofluoric acid and ethylene glycol. Mechanical testing of neogenic bone tissue (tensile strength) was performed on a universal testing machine FP 100/1 by original method. The designed method enables to determine the integral strength of neogenic bone tissue on the implant – host bone interface. Relative tensile strength (σ_{rel}) was determined as the ratio (σ_{NBT}/σ_{NB}), where σ_{NBT} was ultimate tensile strength of neogenic bone tissue and σ_{NB} – ultimate tensile strength of the native compact bone.

Results

According to histological studies, at 4 weeks after surgery the bone tissue of different maturity degrees takes about 30 % of the cross-sectional implants surface, therefore, all the pores interconnected with implant surface are filled completely with bone tissue. Histological reaction around foreign body (presence of multinucleated giant cells, osteoclastic resorption near the implant) was not found. Implant pores are filled with bone tissue due to both ingrowth mature bone trabecules from site of parent bed and through formation of the young bone tissue out of osteogenous progenitor cells.

At 16 weeks in the implants pores there formed the more mature bone structures. In center of implants the areas with immature bone tissue are still remaining. On the implant periphery it can be noticed integration of parent bed bone tissue and newly formed bone trabecules. Analysis of specimens in 52 weeks showed absence of fibrous capsule, no giant cell reaction. In the implantation site of PTi the mineralized bone structures are saved. In the peripheral areas there are signs of reconstruction bone tissue with hardening effects which are expressed more intensely than in PTi ($CN_{0,25}$). In place of introduction PTi ($CN_{0,25}$) the cortical plate is restored. Bone tissue integrates 1/3 implant diameter. Central bone tissue is thickened. The results of examination of neogenic bone tissue quality are shown on Fig. 1. Modification of porous titanium by $CN_{0.25}$ films improve quality of bone tissue which formed in the pores of implants.

The results of neogenic bone tissue tensile strength evaluation are presented in Fig. 2. As seen from Fig. 2, the bonding strength of the implant with the host bone is quite high after 4 weeks already. Relative tensile strength (σ_{rel}) of PTi($CN_{0.25}$) is higher than PTi implants. In 16 weeks the average strength of a neogenic tissue in the implant – host bone interface increased in a row: σ_{rel}(PTi) < σ_{rel} (PTi ($CN_{0,25}$)). At 52 weeks all implants showed the ultimate tensile strength values close to those of the contralateral limb compact bone. In two cases the failure occurred not at the interface of implant-host bone, but in the native bone area, that suggested a solid bone tissue formation at bed-implant interface.

Resume

In vivo study the implants made of porous titanium and porous titanium with $CN_{0.25}$ films, showed that all implants are biocompatible. It was no case of the implant rejection. Osteogenesis begins with ingrowth of bone trabecules from the parent bed and forming new bone tissue from osteogenic cell progenitors, cultured in vitro. With extension of implantation time the reconstruction of the young bone tissue in the more mature structure leads to their integration with tissue from the periphery of implant. This process is the most active in the porous titanium modified by nanocomposite amorphous carbon nitride films obtained by vacuum pulsed arc sputtering of graphite target in presence of nitrogen.

The work is submitted to the International Scientific Conference «Modern problems of experimental and clinical medicine», Thailand (Pathaya), February 21-28th, 2011, came to the editorial office on 27.12.2010.