REPARATIVE ACTION OF NANOMATERIALS FROM RARE EARTH METAL FOR THE TREATMENT COMPLICATIONS OF DIABETES

Belkina I. O.[1)], Sharun E. V.[1,3)], Merzlikina I. S.[2)],
Karpenko N. A.[1)], Koreneva E. M.[1)]
[1)] SI "V. Danilevsky Institute for Endocrine Pathology Problems of the NAMS of Ukraine"; [2)] National University of Pharmacy, [3)] V. N. Karazin Kharkiv National University, Kharkiv, Ukraine
inna-bel@mail.ru

Introduction. Due to development the epidemic of diabetes worldwide grows its importance as a morbidity factor due to the development of diabetic foot syndrome. Ulcers on the foot in case of infections are the cause of disability, morbidity and even mortality. The social significance of the development of new drugs with reparative activity is to raise the effectiveness of the treatment of patients with diabetes.

In recent years, perspective as antidiabetic agents considered containing compounds of rare earth metal that can mimic the action of insulin, reduce insulin resistance, and exercise insulin-retaining activity. Therefore, using of the compounds in the form of nanoparticles makes perspective efforts to create medicines with high reparative activity. It is reasonable to study of fundamental issues - namely, correlation of biometrical parameters of nanoparticles (form-factor) and the parameters of their environment with biological activity of new compounds. In addition, full use of the advantages of nanotechnology in medicine requires an adequate assessment of dangers associated with nanomaterials, that is, the study of parameters of accumulation and distribution of nanoparticles in the body.

Aim. To development a reparative properties new innovative non-toxic compounds in form of nanomaterials for the treatment of complications of diabetes.

Materials and methods. Our experiments were carried out on outbred mice weighing 18 – 28 g that were on a standard diet of food and water according to sanitary norms. All animal studies were conducted according to international principles of the "European Convention for the Protection of vertebrate animals used for experimental and other scientific purposes" (Strasbourg, 1986) and "General ethical principles of animal research" (Ukraine, 2001). Modelling of diabetes in mice was reproduced by intraperitoneal introduction of streptozotocin at a dose of 45 mg/kg for 4 days. After 6 weeks it was carried out wounding operation. Mice were anesthetized; the dorsal skin was shaved, treated with depilatory cream and cleansed with iodine solution. Mice were kept warm during anesthesia and surgery using a heat lamp. Four full-thickness round wounds were created on the dorsal surface of the

mice. Wounds were next covered with gel of nanoparticles, basis of gel or Wundahyl for 14 days of intact and diabetic mice. The control wounds were not covered. Nanoparticles were made in Institute for Scintillation Materials of the NAS of Ukraine. Wounds were photographed on days 1, 3, 5, 8, 11, 14 days using a digital camera. A ruler was included in each image for spatial calibration. Three independent readers evaluated wounds for percent closure. The wound area was determined by Universal Desktop Ruler, measuring this area in square mm. At 0 and 14 days was measured blood glucose level. Mice were euthanized 14 days after wounding. Comparison of the results with the initial parameters of the sampling and the data of control group was made using Mann-Whitney test with the Statistica 6.0. P values ≤ 0.05 were considered statistically significant.

Results and discussion. When we evaluated the closure of full-thickness skin wounds on the dorsum of mice without diabetes, we found that the nanoparticles-treated and Wundahyl-treated wounds showed a more rapid healing of wounds relative to control. Wounds covered with nanoparticles closed earlier than Wundahyl-covered wounds, wound was smaller and less risk of infection. Wundahyl treatment displayed an increase of wound area at the first five days as compared to first day, wound healing occurs from 11 day.

Wounds heal more slowly in diabetic mice than in mice without diabetes. Wounds covered with the basis of gel were not displayed statistically significant differences with wound at 14 day of diabetic mice without treatment. Nanoparticles-treated wounds revealed more rapid wound healing and smaller wounds area as compared to control. Wundahyl treatment showed a faster healing of wounds in mice with diabetes than the closure wounds without treatment. The wounds area at 14 day observed no difference between wounds of non-diabetic mice.

Conclusions. These results indicate that Nanoparticles from rare earth metal may provide a means to improve healing of poorly healing diabetic wounds and treatment the complications of diabetes.