Short Reports

PERSPECTIVE METHODS OF SURGERY TREATMENT OF INFECTED WOUNDS

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Intorduction. Use of laser and nanotechnologies is considered to be quite relevant and perspective direction in contemporary experimental medicine [1]. Among variety of modern methods of modeling of infected wound the best method is use of high-intensive laser, that allows to simulate the wound of experimental animal: to get exact area and depth of lesion [2]. There is a little number of reports about use of laser radiation and nanoparticles of metals in experimental surgery [3]. In some researches of native and foreign authors the effectiveness of application of low-intensive laser radiation is high valued in combined treatment of infected wounds [4, 5]. It is showed that use of low-intensive laser for control of interstitial transport of metal nanoparticles allows to change hydropenetrability of tissue due to formation of canals and pores in 20 times [6], and laser influence boosts the penetration of metal nanoparticles in tissues [7]. It is discovered that use of low-intensive laser radiation in treatment of infected wounds provides with antimicrobial effect, stimulates the process of regeneration, improves microcirculation in area of wound [8, 9, 10]. It is proved by morphological examination, that use of low-intensive laser radiation stimulates macrophage reaction, activates biosynthetical function of fibroblasts, optimizes angiogenesis, promotes to faster maturation of granulation tissue and its fibrous transformation, which ends by 7–8th day [11]. In some foreign researchers' opinion, use of low-intensive laser radiation provides with faster wound purification, early formation of granulation, epithelization of wound defects and shortening period of treatment [12, 13]. Nanoparticles of copper shows expressive bacteriostatic and bactericidal effect and this effect is prolongated and less toxic in comparison with copper salts [1, 9]. In researches in vitro it is stated, that nanoparticles of copper have very expressive antibacterial effect on clinical culture of Staphylococcus aureus [8, 14]. Concentration of nanoparticles more than 100mg/ml is toxic and it is potential dangerous for organism [15]. Wound healing effect of copper nanoparticles is proved. In comparison with antibiotics copper nanoparticles don't cause selection of resistant cultures. This conclusion allows to recommend anoparticles of copper for treatment of infected wounds caused by polyantibiotic resistant cultures [16]. Combined use of nanotechnologies and laser radiation has not found its wide use in experimental medicine. There is a little number of reports about this developments [15, 17]. In our researches it is proved that combined use of low-intensive laser radiation and nanoparticles of copper provides with fast and effective suppression of pathogenic microorganisms' growth and acceleration of regeneration [1, 3]. First results of potentiating effect of low-intensive laser radiation and nanoparticles of copper were reported by V.V. Alipov in Hannover in 2012 [18]. This way, experimental justification of metal nanoparticles' efficiency, searching the way of strengthening of its bactericidal effect including in combination with low-intensive laser effect on wound is the actual concept in modern surgery during treatment of infected skin wounds and soft tissues.

Urgency. Invent the method of infected wound simulating with help of laser and to prove the efficiency of joint application of low-intensive laser radiation(LILR) and nanoparticles of copper in experiment.

Materials and methods of research. 30 white rats (weight = 190–200 g) were used for experiment of infected wound simulating. 100 similar rats were used for exploration of joint application of LILR and copper nanoparticles during the treatment of simulated infected wound. The expression of antimicrobial influence of laser radiation and copper nanoparticles was rated relative to Staphylococcus aureus according to McFarland Turbidity Standart. In the first series of experiment wound was irradiated by laser machine "Matrix";in the second – there was injection of copper nanoparticles;in the third – joint application of LILR and nanoparticles of copper.

Results of research and their discussion. The worked out way with use of high-intensity laser (Lasermed 1001) permits to simulate the wound: in depth and in the area of lesion. And after injection of Staphylococcus aureus it allows to get infection of wound. In experiment in vivo next aspects were registered: low antibacterial activity of: LILR using and expressed bactericidal activity of copper nanoparticles. Experiment also allowed to discover the potentiation of antimicrobial effect during the joint application of copper nanoparticles and the laser. Combined local use of laser radiation and copper nanoparticles to infected wounds of experimental animals provided stopping of pathogenic microflora seeding by the 7th day, rise of granulation by the 4th day and wound epithelization by the 14th day.

Summary. As a result of conducted investigation with use of surgical laser «Lazermed 1001» it was discovered the experimental model of the wound controllable in depth and in the area of affection. Local application of copper nanoparticles transcends the efficiency of laser influence, and in combination with laser irradiation speeds stopping of infectious process in wound on 6 days and wound epithelization, which is noted by 10th day of treatment. It was experimentally validated the appropriateness of combined use of LILR and copper nanoparticles' suspension during surgical treatment of infected burning wounds, which was vindicated by shortening of term of treatment at 22,0 %

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