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Application of cryopreserved placental polypeptide complex in murine acubarotrauma model

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A mild concussion or acubarotrauma is one of the most common defeats of wartime, which leads to the disability of the injured and requires the improvement of existing measures for treatment and rehabilitation. Modern studies have proven neurotrophic and anti-inflammatory effects of placenta derivatives as a means of regenerative medicine, however, such studies have not yet been conducted with acubarotrauma.

The aim of the work was to determine the impact of mild acubarotrauma and the subsequent use of the cryopreserved placental polypeptide complex on survival, physical condition and neurological status of mice.

Mild acubarotrauma (MA) was modeled by a single blast of 30 psi per square inch in *Balb-c* mice. Animal survival, weight, strength, endurance, and neurological impairment status were assessed within one hour after MA and 1, 7, 14, 21 and 28 days later. The parameters of animals before the modeling of MA were used as controls. Experimental group 1 consisted of 26 mice that received MA. Group 2 consisted of 14 mice that received intraperitoneal injection of cryopreserved placental polypeptide complex (CPPC) diluted with saline at a concentration of 20 μg/20 g of mouse body weight (100 μl of solution) every day for 1 month after MA.

In mice of group 1, survival rate was 76.9%, several animals had convulsions, bleeding from the nose and mouth, muscle hypertonicity. The weight increased during the observation period, 1/3 of animals had a disorder of one to five reflexes, 2/3 of animals had minimal endurance scores, which were restored after a month. In group 2, the survival rate of animals was 100% against the background of treatment. The injury did not affect body weight, endurance was restored from the 3rd week, and neurological status – after a month of treatment.

The use of cryopreserved placental polypeptide complex has a positive effect on the condition of experimental animals after mild acubarotrauma, ensures their survival and restoration of the neurological status, which substantiates the prospects for further studies of the use of cryopreserved placental polypeptide complex in treatment and rehabilitation programs for victims of acubarotrauma.

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The role of nanobiotechnology in improving cryopreservation methods for cells and tissues

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Cryopreservation is an extremely important technique for preserving biological materials in modern medicine and biotechnology. It is applied in reproductive technologies, preservation of cells, organs, and research related to medical applications, particularly in transplantation. The advent of nanotechnology has made the use of nanoparticles to enhance the efficiency of freezing processes particularly significant. However, alongside the potential to improve the quality and reliability of cryopreservation, questions arise regarding the safety of nanoparticle use, including a comprehensive assessment of their toxicological profile, mechanisms of interaction with biological systems, and potential risks of application (Goltsev A, 2020).

The aim of our research was to analyze studies on the safety of using nanoparticles in cryopreservation processes, including the assessment of toxic risks, as well as to review modern technological approaches that utilize nanomaterials to enhance the efficiency of cryopreservation of cells and tissues.

In modern cryopreservation practice, nanomaterials are frequently applied to reduce the harmful effects of ice crystal formation, improve heat dissipation, and decrease the toxicity of traditional cryoprotectants. Nanoparticles can serve as carriers of cryoprotectants, ensuring a more uniform distribution of protective substances in cells and tissues, allowing a reduction in the amount of traditional toxic cryoprotectants, which is a crucial step in enhancing the safety of freezing and thawing procedures. Numerous scientific literature data, for instance, demonstrate the positive impact of nanoparticles as cryoprotectants on the motility, viability, and membrane integrity of spermatozoa after thawing (Asadi Z, 2023; Tsekhmistrenko SI, 2022).

Despite significant advantages, studies have also identified several risks associated with the use of nanoparticles. The main issues include excessive accumulation of nanoparticles, which may lead to increased toxicity upon repeated use, genotoxic effects of some nanoparticles capable of causing oxidative stress and DNA damage, interaction of nanoparticles with the immune system, which may lead to inflammatory processes and disruption of cellular metabolism. Additional drawbacks include the high cost of nanomaterials and the need for standardization of control methods (Janjua TI, 2023; Bojic S, 2021).

Thus, it can be concluded that nanobiotechnologies open new opportunities for cryopreservation in tissue engineering, capable of improving the quality of biomaterials for research and transplantation. Promising areas include the development of biocompatible nanomaterials, integration with automated freezing systems, and scaling for clinical application.