Probl Cryobiol Cryomed 2024; 34(4):291
https://doi.org/10.15407/cryo34.04.291

Стабільність еритроцитів ссавців при зміні осмотичних умов середовища

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Stability of Mammalian Erythrocytes Under Varying Osmotic Conditions of the Medium

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Currently, it is extremely important to have proper reserves of donor blood and their components in the conditions of hostilities in Ukraine, hence a long-term storage of mammalian erythrocytes remains one of the priorities in cryobiology. Therefore, the research was aimed to study the sensitivity of mammalian erythrocytes to the action of various cryoinjury factors, implemented at different stages of cryopreservation, which is necessary for further development of storage protocols.

The purpose of research was to study the sensitivity of human, canine and rabbit erythrocytes to the effects of hypotonic stress, hypertonic cryohemolysis, hypertonic and posthypertonic shock.

Hypotonic stress (HS) and hypertonic shock (HSH) of erythrocytes were carried out by incubating cells in hypotonic (40–100 mmol/L NaCl) and hypertonic (1.00–4.00 mol/L NaCl) media, respectively, for 5 min. For posthypertonic shock (PHSH), erythrocytes were incubated in hypertonic (1.00–2.00 mol/L NaCl) medium for 20 min, followed by their transfer to saline solution for 5 min. To perform hypertonic cryohemolysis (HC), cells were incubated in a hypertonic medium (1.00–2.00 mol/L NaCl) at 37°C (10 min) followed by cooling to 0°C (10 min). Hemoglobin content in supernatant was determined spectrophotometrically (λ = 543 nm).

When studying the sensitivity of human, rabbit and canine erythrocytes to the action of various osmotic factors there were obtained appropriate hemolytic dependencies, based on which we calculated the indices for comparing the response of mammalian cells to stress. Comparative analysis of mammalian erythrocytes showed that rabbit cells were more stable to the action of HSH, HC and PHSH, that simulated the effect of cryodamage factors on erythrocytes implemented at freezing and thawing stages, respectively. Mammalian erythrocytes form a sequence of decreasing stability under HS conditions such as canine > human > rabbit.

It was shown that human, canine and rabbit erythrocytes were characterized by different sensitivities to osmotic load under conditions of HS, HSH, HC and PHSH, however according to these parameters the canine erythrocytes were closer to human cells. Temperature-osmotic characteristics of canine erythrocytes determined in the research and analysis of reported data indicate the inexpediency of using cryopreservation protocols developed for human erythrocytes for canine cells. The results obtained may further become the basis to resolve the issue of cryopreservation of canine erythrocytes.

Probl Cryobiol Cryomed 2024; 34(4):291
https://doi.org/10.15407/cryo34.04.291a

Вплив низьких температур на збереженість регенеративних властивостей гіалуронової кислоти різної молекулярної маси

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Low Temperatures Influence the Preservation of Regenerative Properties of Hyaluronic Acid with Different Molecular Weight

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Hyaluronic acid (HA) attracts a special attention and popularity at the current stage of development of medical and pharmaceutical sciences. The field of aesthetic medicine and plastic surgery is the undisputed leader in terms of the intensity of HA use and proven high efficiency. High molecular weight HA (HmHA) has depositing and antioxidant properties, remains longer in tissues, on the skin surface and mucous membranes, suppresses cell division and migration of substances to the localization of inflammation. Medium-molecular HA triggers the synthesis of its own endogenous HA, accelerates wound healing, and stimulates cell division.

Low-molecular weight HA (LmHA) easily penetrates into the deep layers of skin, improves the transport of water and substances, stimulates the regeneration of blood capillaries, that is successfully used for treatment of inflammatory processes in the joints, organs of genitourinary system, during cosmetic procedures and contour plastic surgery. Recently, HA is increasingly used in cryobiological research, which makes it necessary to study the effect of low temperatures on the main characteristics of HA.

The preservation of regenerative properties of 1 and 2% aqueous solutions of HmHA (>2,000 kDa) and LmHA (10–100 kDa) was studied in the excision wound healing model in experimental animals. We compared the results of the action of unfrozen solutions and those after freezing by immersion in liquid nitrogen followed by thawing in a water bath at 37°C. The dynamics of wound healing in experimental animals was observed during the week, taking daily photos of the wound healing process.

Analysis of dynamics of wound healing in experimental animals confirmed the presence of pronounced regenerative properties of 1 and 2% aqueous solutions of HA with both high and low molecular weight, that did not change under the influence of low temperatures. The use in the experiment of cooling mode by immersion in liquid nitrogen is the basis for asserting the preservation of regenerative properties of HA when using more gentle freeze-thawing modes. Regenerative properties of HA with low molecular weight were more pronounced. The action of low temperatures caused no decrease in regenerative properties of 1 and 2% aqueous solutions of HmHA and LmHA, that will open up the prospects for its use in cryobiological technologies.