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MECHANICAL STRESS OF MAMMALIAN ERYTHROCYTES

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Mechanical stress is the cause of blood cell membrane damage when using cardiopulmonary bypass systems (O`Leary M.F. et al., 2011). To assess the safety of such systems in preclinical trials one uses animal erythrocytes (Kameneva M.V. et al., 1997). Therefore there is a need in studying the response of human and mammalian erythrocytes to mechanical stress.

We studied here the sensitivity of human, bovine, equine, rat and rabbit erythrocytes to mechanical stress. Erythrocyte suspension was placed into a container with plastic balls and stirred for 2 hours with a magnetic stirrer at room temperature (21°C). The level of hemolysis was determined spectrophotometrically.

In mammalian erythrocytes of all studied species we observed a rise of hemolysis level when increasing mechanical stress duration. These data testify to the absence of any significant damage in erythrocytes under a short incubation (10 min) (damage level for erythrocytes of all mammals is 2-5%). Under 30 min incubation the damage level in rat, equine, human, rabbit and bovine erythrocytes makes 22±3, 16±3, 14±2%, 12±2 and 9±2%, respectively. At a long-term effect of mechanical stress (60 min) the highest level of hemolysis is shown in rat (30±4%) and human (26±3%) erythrocytes. The differences in values of mechanical hemolysis in bovine, equine and rabbit erythrocytes are not statistically significant, being within the range of 21-23%.

The parameter determining the erythrocyte sensitivity to mechanical stress may be surface-volume ratio (S/V), which serves as one of the factors determining cell ability to the deformation (Plasenzotti R. et al., 2004). Thus, the rat erythrocytes, being the most sensitive to mechanical stress, have the lowest S/V value among the studied species of mammals. The equine, bovine and rabbit erythrocytes have similar S/V values, which are consistent with the absence of differences in their sensitivity to mechanical stress during its prolonged exposure.

Thus, the level of mechanical damage of erythrocytes depends on the mammalian species and mechanical stress duration. It should be noted that the results presented in our work and further studies in this direction are important for extrapolation of the experimental data obtained in animals to human erythrocytes in order to provide a safe clinical application of the equipment, causing mechanical damage to erythrocytes.

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