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Kinetic cryoprotectant free vitrification using KrioBlast™ System: A promising universal technology of cryopreservation and cryobanking

Igor I Katkov^{1,2}¹Celltronix, USA²Belgorod State University, Russia

Cryopreservation (CP) and subsequent long-term storage (cryobanking) are important parts of both life science research and related industries and technologies. Slow freezing (SF) is the mainstream of the majority of CP technologies. It however, requires multi-step protocols, expensive programmable freezers, and must be tuned to the particular types of cells, tissues and organs. Ice-free vitrification (VF) is an alternative approach to SF, which is gaining momentum for CP of oocytes, embryos, and some other type of cells. However, the traditional equilibrium vitrification (E-VF) requires high concentrations of permeable cryoprotectants that can be both chemically toxic and inflict substantial osmotic damage to the cells. As the alternative to both SF and classic E-VF methods, we have introduced the KrioBlast™, an entirely system for hyperfast (100,000 K/min) and scalable (thousands of microliters) kinetic vitrification (K-VF) that is based on spray cooling of hermetic (closed) cryocontainers and allows to completely eliminate the Leidenfrost effect, which currently greatly impedes maximal achievable cooling rate. It is simple, robust, and can achieve VF for practically any type of cells, which makes it a permeable cryoprotectant-free universal system as soon as the sample has the thickness below 20 mm, which comprise 90% of modern market of cryopreserved samples. Preliminary experiments have shown feasibility and very high survival (up to 90%) of cryopreserved human spermatozoa and pluripotent stem cells. Particular applications of the K-VF approach and KrioBlast™ technology for CP and cryobanking for reproductive and regenerative medicine, husbandry, and cryopreservation of wildlife genetic resources are also discussed.

Biography

Igor I Katkov is a trained Biophysicist with more than 30 years of experience in Cryobiology and Cryogenic Engineering. In the last 5 years, his research has been focused on the fundamental aspects of Kinetic Vitrification (K-VF) as well as on designing the practical system for K-VF KrioBlast™. He is the Chief Scientific Officer of Celltronix (San Diego, CA, USA). He has recently accepted a Professor-level position as the Head of the Laboratory at the Belgorod State University, Russia.

prodvincell@hotmail.com

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