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Scaffold-free, label-free and nozzle-free biofabrication technology based on magnetic levitational assembly

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Tissue spheroids have been proposed to use as building blocks in biofabrication and 3D bioprinting technologies. Label-based magnetic forces-driven 2D patterning of tissue spheroids requires cell labeling by magnetic nanoparticles. Recently novel label-free approach for magnetic levitational assembly has been introduced. Here we report a first time rapid assembly of 3D tissue engineered construct using scaffold-free and label-free magnetic levitation of tissue spheroids. Tissue spheroids (so-called chondrospheres) of standard size and shape capable of tissue fusion have been biofabricated using non-adhesive cell culture flasks from primary culture of ovine chondrocytes. Label-free magnetic levitation has been performed using experimental set with permanent magnets in presence of gadolinium in cell culture media which enables magnetic levitation. Potential toxic effect of gadolinium has been systematically evaluated. Mathematical modeling and computer simulations have been used for modeling of magnetic field and kinetics of tissue spheroids assembly into 3D tissue constructs. Plastic beads have been initially used as physical analogs of tissue spheroids for determining an optimal regime of magnetic levitation in presence of parmagnetic gadolinium medium. It has been shown that chondrospheres were able to rapidly assemble into 3D tissue construct in the permanent magnetic field in presence of gadolinium in cell culture media. Thus, label-free magnetic levitation of tissue spheroids represents a perspective approach for rapid scaffold-free 3D biofabrication and an attractive alternative to label-based magnetic tissue engineering.

Biography

Vladimir Mironov has graduated from The Ivanovo State Medical University (MD) in Ivanovo, Russia and obtained his PhD in Developmental Biology at The Second Moscow Medical University in Moscow, Russia. He has worked at Max Plack Institute for Psychiatry, Germany and then at the Department of Regenerative Medicine and Cell Biology of The Medical University of South Carolina, USA, where he was the Director of Advanced Tissue Biofabrication Research Center. He has worked several years in Brazil as FAPESP and CNPq funded Visiting Professor at The Division of 3D Technology at The Renato Archer Center for Information Technology in Campinas, Brazil and at The Life Science Division of The National Metrology Center (InMetro) in Rio de Janeiro, Brazil. He has also worked as a Chief Scientific Officer of Russian start-up 3D Bioprinting Solutions which developed first Russian multifunctional 3D Bioprinter Fabion and print a first functional animal organ; mouse thyroid gland.

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