Scientists find optimal age of stem cells

May 27 2020

Window of opportunity. Credit: Daria Sokol/MIPT

Biophysicists from the Moscow Institute of Physics and Technology and Vladimirsky Moscow Regional Clinical Research Institute have determined the optimal age of reprogrammed stem cells suitable for restoring heart tissue. It spans the period roughly from day 15 until day 28 of maturation. The research findings were published in *Scientific Reports*.

Induced pluripotent stem cells, or iPSCs, are used in regenerative medicine. Derived from human blood, these cells undergo chemical

"rejuvenation," and the resulting stem cells can be reprogrammed into cells of various types. This makes it possible to restore tissue with cells that the body recognizes as its own.

It was previously believed that mature cells, aged more than two months, should be used to restore heart tissue. A team of researchers led by MIPT Professor Konstantin Agladze set out to test experimentally which reprogrammed stem cell age is the best for that purpose.

The biologists introduced iPSCs of different ages into human heart cell cultures and tested the quality of the resulting cardiac tissue. This involved optically mapping the behavior of the tissue under induced excitation waves. The test imitates the functioning of the cardiac muscle in the body. In order for the heart to contract correctly, the excitation wave needs to propagate across the cell ensemble consistently.

The cells introduced between days 15 and 28 of maturation proved to form a consolidated excitable system with the heart cells initially present in the culture. No such system emerged when the team waited until after day 28.

"We found that after day 28 of differentiation, the cells are no longer usable, because they do not merge into a homogeneous tissue with the heart cells. Adhesion does occur, but there is no unity, and the implanted cells are not functional," said Konstantin Agladze, who heads the Excitable Systems Biophysics Lab at MIPT.

The laboratory conducts fundamental research in the field of regenerative medicine, with a focus on cardiomyocytes—the cells that make up the heart muscle. The team's work underlies recommendations for those implementing the regenerative approaches; and the study reported in this story is important for identifying the "window of opportunity" when stem cells should best be used in tissue restoration.

More information: M. M. Slotvitsky et al. Formation of an electrical coupling between differentiating cardiomyocytes, *Scientific Reports* (2020). DOI: 10.1038/s41598-020-64581-5