Rigid growth matrix: A key to success of cardiac tissue engineering

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A new study by researchers at UCLA suggests that the elasticity of the physical matrix used for growing heart muscle cells outside of the body may be critical to the success of cardiac tissue engineering. The results were published in the journal *Science and Technology of Advanced Materials* this week.

Adult heart muscle is the least regenerative of human tissues. But embryonic cardiomyocytes (cardiac muscle cells) can multiply, with embryonic stem cells providing an endless reservoir for new cardiac tissue. A new study by Nakano, Gimzewski and their co-workers at the University of California, Los Angeles (UCLA) suggests that the elasticity of the physical matrix used for growing cardiomyocytes outside of the body may be critical to the success of cardiac tissue engineering efforts.

Published in the journal *Science and Technology of Advanced Materials*, the study found that a stiff or rigid environment not only enhances the function of existing cardiomyocytes (as has previously been shown), but also promotes the generation of cardiomyocytes from embryonic stem (ES) cells. It may therefor be possible to grow new heart muscle tissue from stem cells by manipulating the stiffness of the medium they're grown in.

In living organisms, a type of adult stem cells called mesenchymal stem cells (MSCs) are extremely sensitive to the elasticity of different materials, when cultured outside the body. For example, soft growing

matrices that mimic brain tissue promote the differentiation of MSCs into neurons, while rigid matrices that resemble bone tissue promote the differentiation of MSCs into bone cells.

In this study, the UCLA team examined the role of matrix elasticity on cardiac muscle development using mouse and human embryonic stem cells, which were grown on different substrates of a silicon-based organic polymer that varied in stiffness. The team found that rigid matrices promoted the generation of more cardiomyocytes cells from ES cells. In addition, ES-derived cardiomyocytes displayed functional maturity and synchronization of beating when cultured with cardiomyocytes harvested from a developing embryo.

The team recommends further research on how biophysical cues determine the fate of embryonic stem cells in order to improve cardiac tissue culture methods for regenerative medicine purposes.

More information: Arshi, A. et al. Rigid microenvironments promote cardiac differentiation of mouse and human embryonic stem cells, *Science and Technology of Advanced Materials* 14 (2013) 025003. doi:10.1088/1468-6996/14/2/025003

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