New method generates cardiac muscle patches from stem cells

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A cutting-edge method developed at the University of Michigan Center for Arrhythmia Research successfully uses stem cells to create heart cells capable of mimicking the heart's crucial squeezing action.

The cells displayed activity similar to most people's resting heart rate. At 60 beats per minute, the rhythmic electrical impulse transmission of the engineered cells in the U-M study is 10 times faster than in most other reported stem cell studies.

An image of the electrically stimulated cardiac cells is displayed on the cover of the current issue of Circulation Research, a publication of the American Heart Association.

For those suffering from common, but deadly, heart diseases, stem cell biology represents a new medical frontier.

The U-M team of researchers is using stem cells in hopes of helping the 2.5 million people with an arrhythmia, an irregularity in the heart's electrical impulses that can impair the heart's ability to pump blood.

"To date, the majority of studies using induced pluripotent stem cell-derived cardiac muscle cells have focused on single cell functional analysis," says senior author Todd J. Herron, Ph.D., an assistant research professor in the Departments of Internal Medicine and Molecular & Integrative Physiology at the U-M.

"For potential stem cell-based cardiac regeneration therapies for heart disease, however, it is critical to develop multi-cellular tissue like constructs that beat as a single unit," says Herron.

Their objective, working with researchers at the University of Oxford, Imperial College and University of Wisconsin, included developing a bioengineering approach, using stem cells generated from skin biopsies, which can be used to create large numbers of cardiac muscle cells that can transmit uniform electrical impulses and function as a unit.

Furthermore, the team designed a fluorescent imaging platform using light emitting diode (LED) illumination to measure the electrical activity of the cells.

"Action potential and calcium wave impulse propogation trigger each normal heart beat, so it is imperative to record each parameter in bioengineered human cardiac patches," Herron says.

Authors of the study note that the velocity of the engineered cardiac cells, while faster than previous reports, it is still slower than the velocity observed in the beating adult heart.

Still the velocity is comparable to commonly used rodent cells, and authors suggest human cardiac patches could be used rather than rodent systems for research purposes.

The new method can be readily applied in most cardiac research laboratories and opens the door for the use of cardiac stem cell patches in disease research, testing of new drug treatments and therapies to repair damaged heart muscle.

More information: "Simultaneous Voltage and Calcium Mapping of Genetically Purified Human Induced Pluripotent Stem Cell–Derived

Medical Xpress

Cardiac Myocyte Monolayers," *Circulation Research*, June 8, 2012; 110: 1556-1.

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