Supportive materials will help regenerate heart tissue (w/ Video)

December 8 2009

Bioengineers from University of California, San Diego are developing new regenerative therapies for heart disease. The work could influence the way in which regenerative therapies for cardiovascular and other diseases are treated in the future.

New results from UC San Diego on using adult stem cells to regenerate heart tissue in environments that mimic a human post-heart-attack heart were presented this week in San Diego at the 2009 annual meeting of the American Society for Cell Biology (ASCB). The work is from the laboratory of Adam Engler from the Department of Bioengineering at the UC San Diego Jacobs School of Engineering.

Every year in the United States, approximately 900,000 people die from heart disease. The prevalence of heart disease has prompted researchers to develop new regenerative therapies to treat the condition, including the injection of adult stem cells into the scarred heart muscle that results from a heart attack. This treatment, called cellular cardiomyoplasty, relies on injected stem cells receiving appropriate cues from their surrounding tissue to cause them to become cardiac muscle.

However, when stem cells are injected into stiff, scarred, post-heart attack muscle (rather than healthy tissue), these stem cells do not readily become cardiac muscle. In fact, only marginal improvement in overall cardiac function has been detected, and this improvement may not actually be from tissue regeneration. Instead, the improvements may be from the fact that the treatment "pokes holes" into the scar tissue and

injects soft cells, making it slightly softer and thus more functional. Even more striking, the injected stem cells do not form new cardiac muscle. Instead, the stem cells form small calcified lesions. The injected stem cells are directed by the stiff scar tissue to mature into bone-like cells rather than new heart cells.

Given these problems associated with direct stem cell injection, the UC San Diego bioengineers are proposing to use cells placed in a supportive material that changes stiffness with time by exhibiting time-dependent crosslinking.

"Our evidence suggests that tissue-specific stiffness arises from key developmental changes, which implies that cells should be cultured in the appropriate physical conditions that mimic embryonic tissue progression, from soft, pre-cardiac tissue at early embryonic age to a mature, less compliant tissue at the conclusion of development," said Jennifer Young, a Ph.D. candidate in bioengineering at UC San Diego and the first author on the peer-reviewed presentation at ASCB 2009.

By tuning this material to mimic in situ time-dependent stiffness changes, the UC San Diego bioengineers have found that cells placed in this material indicate improved cardiac differentiation.

"Results from this study may not only have a profound impact on cardiovascular engineering, but may influence the way in which many regenerative therapies are conducted. In this instance we have studied the developing tissue as a model, and from it generated a set of design criteria to mimic in our new material," said bioengineering professor Adam Engler from the UC San Diego Jacobs School of Engineering.

Source: University of California - San Diego (news : web)