New Device Provides a Major Boost to Adult Stem Cell Research

A single cell with the potential to repair damaged heart muscle tissue . . . regenerate injured bone . . . create new cartilage or skin . . . even reverse nerve damage. Human stem cells offer tremendous hope for the development of revolutionary medical treatments for these and a variety of other human health problems. Up until now, however, stem cell research has been slowed by ethical controversy - as well as by the rarity of the extraordinary cells themselves.

That could be about to change: A Florida State University research team reports that it has designed a biomedical device that will allow stem cells derived from adult bone marrow to be grown in sufficient quantities to permit far more research - and allow faster growth of tissues that can be transplanted into patients.

Teng Ma, an assistant professor of chemical and biomedical engineering at the Florida A&M University-FSU College of Engineering, and colleagues have created a device called a perfusion bioreactor that is designed to mimic conditions encountered by adult stem cells within the human body. The reactor bathes stem cell samples in a protein-rich liquid while also simulating the flow of the body's circulatory system.

"Within the human body, each cell is no more than 200 micrometers from a source of nutrients," Ma explained. "The perfusion bioreactor allows us to deliver essential nutrients to stem cells in a manner very similar to what they are used to within the body."

By altering that flow of nutrients to the stem cells, researchers also hope to control what type of cell they ultimately will become, Ma said.

"The perfusion bioreactor can be used to reproduce mesenchymal stem cells and to direct their differentiation into bone, cartilage, muscle, heart muscle, fat or nerve tissue," Ma said. "The tissues grown then will be suitable for clinical transplantation." He added that stem cells can live for up to 40 days within the bioreactor.

Ma's research has attracted attention on several fronts. He has received research funding totaling about $1.2 million from the Defense Advanced Research Projects Agency, the James & Esther King Biomedical Research Foundation, the American Cancer Society and the FSU Cornerstone Program.
He also recently received two U.S. patents relating to the perfusion bioreactor, and indicates that they are negotiating with a technology company to manufacture the device for other stem cell researchers.

Collaborating with Ma on his perfusion bioreactor research were post-doctoral student Feng Zhao and former graduate student Warren Grayson.

While much of the controversy surrounding stem cell research has centered around the use of cells derived from fetal or embryonic tissue, Ma points out that the mesenchymal stem cells used in his research come from adult donors.

"The National Institutes of Health helped establish the Tulane Center for Gene Therapy at Tulane University as a national distributor of these cells to researchers," he said. "The center is the source of the stem cells we use.

"All of their donors are adults between the ages of 19 and 49. Essentially, each donor undergoes a medical procedure in which a small amount of bone marrow is extracted from his or her pelvic bone."

Within that extracted bone marrow, only about one in every 100,000 cells is a stem cell, Ma said. "Because they are so rare, the ability to reproduce stem cells in a laboratory becomes particularly significant for further research and clinical trials."

Ma's research may lead to important breakthroughs in the field of stem cell research and application, said Bruce Locke, chairman of the department of chemical and biomedical engineering in the College of Engineering. "By addressing one of the key issues constraining this research - a limited supply of stem cells - he could help advance the development of numerous medical therapies by years," Locke said.

According to the Tulane Center for Gene Therapy's Web site, "stem cells are so named because they are like the stems on a tree that can produce new leaves and flowers each year." Each stem cell has the ability to divide so as to produce a perfect copy of itself; the copy then can become a "workhorse" cell, such as a bone or nerve cell.
Because the stem cell produced by this division is a perfect copy of the original stem cell, stem cells seem to be able to divide and live indefinitely, perhaps forever.

Source: Florida State University