Scientists find new way to sort stem cells

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UC Irvine scientists have found a new way to sort stem cells that should be quicker, easier and more cost-effective than current methods. The technique could in the future expedite therapies for people with conditions ranging from brain and spinal cord damage to Alzheimer’s and Parkinson’s diseases.

The method uses electrodes on a tiny, inch-long glass slide to sort cells by their electric charges and has been used in cancer research. The stem cell field suffers from a lack of tools for identifying and sorting cells. This important discovery could add a new tool to current sorting methods, which generally require expensive, bulky equipment.

“For therapeutic purposes, we want stem cells to turn into specific cell types once they have been transplanted. The trick to doing this is identifying beforehand which cells will become the desired cell type, such as a neuron,” said Lisa Flanagan, lead author of the study and a stem cell biologist at UCI. “We have discovered a new, potentially better way to do this by focusing on the electric properties of the cells.”

This study appears online Dec. 20 in the journal *Stem Cells*.

The technique used by the scientists, called dielectrophoresis, is based on the premise that different types of cells have different electric properties. Stem cells that are destined to become neurons, for example, have a different electric charge than stem cells that will become astrocytes, another type of brain cell. The scientists discovered that the cells react differently when electric fields are applied. At one frequency, a neuron will be attracted to an electrode but an astrocyte will not, and at a different frequency, an astrocyte will be attracted but a neuron will not.

Identifying and sorting stem cells is important when creating stem cell-based therapies. Without a purification process, stem cell transplantations can cause tumors or be rejected by the body's immune system.

In this study, the scientists wanted to identify and collect stem cells that were destined to become neurons, which are cells in the brain and spinal cord that process and transmit information. Neurons that die as a result of injury or disease do not regenerate, which is why people with neuronal loss suffer problems such as paralysis and memory loss. Scientists believe that stem cell transplantations might be able to restore part of the lost function.

With the goal of identifying future neurons, UCI engineers built a tiny device using a glass slide to perform the dielectrophoresis. First, scientists place unsorted mouse stem cells on one side of the device. The cells then float in sugar water through a tiny channel past electrodes set to a particular frequency. At a certain frequency, stem cells destined to become neurons will stick to the electrodes while other cells pass by. The cells that stick then can be removed and grouped together, potentially for use in a therapy.

Currently, stem cells most often are separated using a machine called a fluorescence-activated cell sorter (FACS). FACS machines, which use lasers to detect the light scattering and fluorescent characteristics of the cells, can weigh hundreds of pounds and cost $500,000 or more. The UCI-designed dielectrophoresis device is just a fraction of the size and cost. The two devices could be used to complement each other to create ultra pure stem cell populations.

“Once the mold is created, these sorts of devices can cost just pennies to make,” said Ed Monuki, senior author and UCI developmental biologist. “You could have many for every member of your lab and it wouldn’t be prohibitively expensive.”

A strong collaborative partnership between UCI biologists and engineers made this discovery possible. With input from biologists, engineers built the device in UCI’s Integrated Nanosystems Research Facility. “This represents truly an interdisciplinary effort that expands the horizon in both biology and engineering fields,” said Abraham Lee, a study co-author affiliated with the Department of Biomedical Engineering in The Henry Samueli School of Engineering at UCI.

Source: University of California - Irvine

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