Researchers characterize stem cell function

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The promise of stem cells lies in their unique ability to differentiate into a multitude of different types of cells. But in order to determine how to use stem cells for new therapeutics, scientists and engineers need to answer a fundamental question: if a stem cell changes to look like a certain type of cell, how do we know if it will behave like a certain type of cell?

Researchers at Northwestern University's McCormick School of Engineering are the first to fully characterize a special type of stem cell, endothelial progenitor cells (EPCs) that exist in circulating blood, to see if they can behave as endothelial cells in the body when cultured on a bioengineered surface.

The results, published online in the journal Stem Cells show promise for a new generation of tissue-engineered vascular grafts which could improve the success rate of surgery for peripheral arterial disease. Peripheral arterial disease is estimated to affect one in every 20 Americans over the age of 50, a total of 8 to 12 million people.

"Normally, stem cells are not studied in the context of improving vascular grafts for bypass surgery. Therefore, we had to develop new tests to assess their use in this application," says Guillermo Ameer, senior author of the paper and associate professor of biomedical engineering and surgery. "We looked at the function of the cells on a citric acid-based polymer, which will be the basis for a new generation of bioengineered vascular grafts."

In the study, Josephine Allen, then a graduate student in Ameer's lab, and colleagues isolated endothelial progenitor cells from eight tablespoons of blood. In approximately half of the attempts, the team was able to isolate the EPCs to expand to make millions of endothelial cells that can behave like the cells of a blood vessel.

Once the endothelial-like cell colonies were established, the research team performed a battery of tests to examine the properties and functionality of the cell.

"These new tests show that these endothelial-like cells can inhibit blood clotting and can prevent platelets from adhering to their surface," says Ameer. "But if you antagonize the cells or stimulate them, they will also respond the same way that an endothelial cell would and will clot blood if needed."

The study is an important step in identifying methods to build a tissue-engineered vascular graft. Synthetic grafts, used to treat common diseases such as peripheral arterial disease, have lower success rates when used in small-diameter arteries, such as those found in the leg.

"These small-diameter synthetic grafts are more prone to blood clots and other complications, especially over time," Ameer says. "It's thought that a tissue-engineered graft would allow us to preserve many of the body's natural defenses against these complications."

More information: The Stem Cell paper is titled "Toward Engineering a Human Neoendothelium With Circulating Progenitor Cells."

Provided by Northwestern University