'Pure' human blood stem-cell discovery opens door to expanding cells for more clinical use

For the first time since stem cells were discovered here 50 years ago, scientists have isolated a human blood stem cell in its purest form - as a single stem cell capable of regenerating the entire blood system. This breakthrough opens the door to harnessing the power of these life-producing cells to treat cancer and other debilitating diseases more effectively. The study is published today in *Science*.

"This discovery means we now have an increasingly detailed road map of the human blood development system including the much sought after stem cell," says principal investigator John Dick, who holds a Canada Research Chair in Stem Cell Biology and is a Senior Scientist at the McEwen Centre for Regenerative Medicine and the Ontario Cancer Institute, University Health Network (UHN).

"We have isolated a single cell that makes all arms of the blood system, which is key to maximizing the potential power of stem cells for use in more clinical applications. Stem cells are so rare that this is a little like finding a needle in a haystack."

Dr. Dick, who pioneered the field of cancer stem cells with previous discoveries in human leukemia and colon cancer, also developed a way to replicate the entire human leukemia disease process using genetically engineered mice. As well as being a Senior Scientist at UHN's Princess Margaret and Toronto General Hospitals, he is a Professor in the Department of Molecular Genetics, University of Toronto, and Director of the Cancer Stem Cell Program at the Ontario Institute for Cancer Research.

Dr. Dick works out of UHN's Ontario Cancer Institute (OCI) - the venerable institution where stem-cell science began in 1961 with the original discovery of Drs. James Till and Ernest McCulloch - and McEwen Centre for Regenerative Medicine with the next generation of stem-cell scientists focused on developing better and more effective treatments for heart disease, diabetes, respiratory disease and spinal cord injury.

The 1961 Till and McCulloch discovery quickly led to using stem cells for bone marrow transplantation in leukemia patients, the most successful clinical application so far in what is now known as regenerative medicine and a therapy that is used to treat thousands of patients annually around the world.

"Ever since stem-cell science began," says Dr. Dick, "scientists have been searching for the elusive mother lode - the single, pure stem cell that could be controlled and expanded in culture prior to transplantation into patients. Recently scientists have begun to harness the stem cells found in the umbilical cord blood; however, for many patients a single donor sample is not large enough to use. These new findings are a major step to generate sufficient quantities of stem cells to enable greater clinical use and thus move closer to realizing the promise of regenerative medicine for patients."

Along the way, scientists have indeed mapped many vital signposts regarding stem-cell subsets and specialization. Last year, Dr Dick's team reported isolating the more specialized progenitor cells that lie downstream of the stem cell. The discovery published today was enabled by hi-tech flow cytometry technology: a process that rapidly sorts, sifts and purifies millions of blood cells into meaningful bins for scientific analysis. Now, stem-cell scientists can start mapping the molecular switches that guide how "normal" stem cells behave and endure, and also characterize the core properties that distinguish them from all other blood cell types.

This discovery is the one Dr. Dick has personally been seeking ever since 1988 when he developed the first

means of studying human blood stem cells by transplanting them into immune-deficient mice, research that was also published in *Science*. "Back then, our goal was to define single human stem cells. With advances made in technology, twenty-three years later, we have."

More information: Paper online: http://www.sciencemag.org/lookup/doi/10.1126/science.1201219

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