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The Globe and Mail (Metro Ed, ON)

Order/Commande 101447

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MEDICAL RESEARCH » FROM MATURE TO EMBRYONIC

Stem-cell method hailed as 'massive breakthrough'

Researchers successfully modify skin cells in work that helps sidestep ethical concerns

BY ANNE McILROY
SCIENCE REPORTER

Japanese researchers have taken skin cells from the face of a 36-year-old woman and turned them into what appear to be embryonic stem cells. A second team, in the United States, has performed the same feat with cells from infant foreskins.

Their work is being heralded as an important and long-awaited advance, one that may allow scientists to sidestep ethical concerns about harvesting stem cells from human embryos in hopes of developing new therapies for patients suffering from such diseases as diabetes, Parkinson's and Alzheimer's.

"It is a massive breakthrough," said Tim Caulfield, research director of the Health Law Institute at the University of Alberta, who closely follows developments in the field.

In the developing embryo, stem cells have an endless capacity for self-renewal and give rise to every type of cell in the body – skin, muscle, bone, heart, liver, kidney, brain and more than 250 other kinds of specialized cells.

Restoring these powers in mature cells allows scientists to avoid ethical debates over getting embryonic stem cells from aborted fetuses. Another controversial approach to obtaining stem cells – as yet unsuccessful – involves cloning embryos from adult humans.

The reprogramming technique has a number of serious drawbacks, however, and involves at least one gene that can cause cancer.

In separate papers published by respected journals, the Japanese and American teams describe how they got mature cells to behave exactly like embryonic stem cells without creating or destroying embryos; they took four genes that play an important role in stem cells and put them into mature cells.

The reprogramming technique has a number of serious drawbacks, however, and involves at least one gene that can cause cancer. Experts caution that it is still far too early to know if the work will in fact lead to new ways to treat disease, or prove to be the best approach to obtaining stem cells.

But it will give researchers a powerful new tool to study the causes of complex diseases such as Alzheimer's, says Mick Bhatia, a prominent stem-cell researcher who works at Hamilton's McMaster University.

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Scientists will be able to take skin cells from a patient suffering from the degenerative brain disorder and transform them into embryonic stem cells, he says. The next step would be to then coax the stem cells to turn into brain cells. Researchers can then study those brain cells to understand what has gone wrong, or use them to screen potential new drugs.

"It is very exciting," Dr. Bhatia said.

Last year, the leader of the Japanese team, Shinya Yamanaka, announced he had reprogrammed mouse-tail skin cells into an embryonic state using four genes. In June, he published results showing those cells had the ability to become any type of cell in the body. Some scientists questioned whether the technique would work in humans.

Dr. Yamanaka tried first with cells taken from the 36-year-old Caucasian woman, and was also successful using cells from a 69-year-old male.

At the University of Wisconsin, stem-cell pioneer James Thomson was performing similar experiments with skin cells taken from the foreskins of newborn babies.

Their race ended in a tie; Dr. Yamanaka published his paper online yesterday in the journal Cell. Dr. Thomson reported his results in the online edition of the journal Science.

Both techniques involve four genes – two in common, two different. Both teams focused on genes that play an important role in embryonic stem cells, and control when other genes get turned on and off.

Both reported that the reprogrammed cells behave exactly the same as human embryonic cells.

"By any means we test them, they are the same as embryonic stem cells," Dr. Thomson said.

But he and his colleagues must perform more follow-up studies to be sure, he says.

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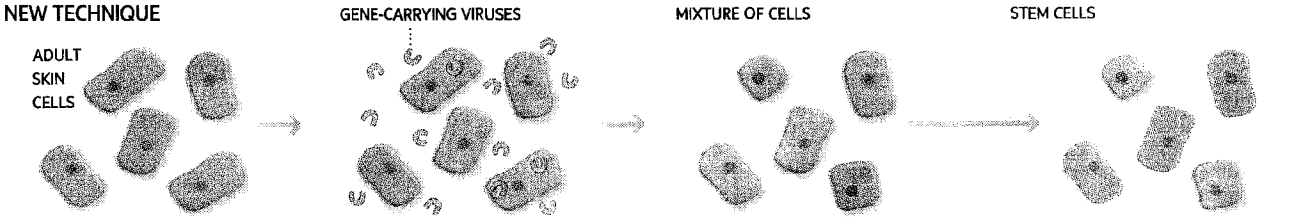
How they get cells to change

Two separate teams of researchers have announced a technique that allows them to turn human skin cells into what appear to be embryonic stem cells.



1. The process begins with a large number of such cells.
2. The skin cells are exposed to viruses, each carrying one of four critical genes.
3. Cells that absorb all four genes somehow seem to be converted into stem cells.
4. Researchers kill any unconverted cells, leaving behind seemingly viable stem cells.

James Thomson looks at a culture in 2005. UNIVERSITY OF WISCONSIN PHOTO/JEFF MILLER

Junying Yu, seen this month, is an assistant scientist with the University of Wisconsin-Madison Primate Research Center and the Genome Center of Wisconsin. UNIVERSITY OF WISCONSIN PHOTO/BRYCE RICHTER