eReview
LATEST DEVELOPMENTS IN FAMILY FRIENDLY RESEARCH
INSTITUTE OF MARRIAGE AND FAMILY CANADA
No. 53 OCTOBER 22, 2008

The eReview provides analysis on public policy relating to Canadian families and marriage.

Advances in stem cell research

Is choosing between good science and good ethics a debate of the past?

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As Canadians contemplated the pending election last week, an important study was published in the science journal *Nature Biotechnology*. Quietly overlooked, it has the capacity to fundamentally alter how we conduct stem cell research. [1] Such research has been the subject of much controversy. Embryonic stem cells, some scientists claim, hold the cure for many difficult diseases, like spinal paralysis, Alzheimer's and Parkinson's. [2] Yet creating human life, only to destroy it, even for admirable goals, creates an ethical dilemma. Does this recently published study make that debate a thing of the past?

Embryonic stem cells used for research are obtained through the destruction or cloning of human embryos. The ethical dilemma inspired researchers to find a new way to access the potential of embryonic stem cells without destroying human life. In 2006, two Japanese scientists announced the discovery of a process to do just this—by inserting human genetic material into adult stem cells. [3] The genetic material reprograms the adult stem cells so that they have the properties of embryonic stem cells. The new stem cells are called induced Pluripotent stem cells (iPS).

The new October 2008 study shows that reprogramming can be accomplished with half the genetic material previously required and an acid to treat the adult stem cells. They write:

> Our results raise the question of whether, or how soon, it will be possible to find small molecules to replace OCT 4 and SOX2 [the two human genes inserted] and thereby achieve reprogramming through purely chemical means, making therapeutic use of reprogrammed cells safer and more practical. [4]

In short, this research opens the way for an eventual method of reprogramming that does not require human material, but rather chemical matter.

The background on stem cell research

Stem cells are like the building blocks of the human body. The Stem Cell Network, an Ottawa-based group that brings stem cell experts together, defines stem cells as those "occur[ing] at the earliest stages of development and provide the starting material for every organ and tissue." [5]

In theory, stem cells could be used to repair or rebuild wounded or broken parts of the body—inject them into a severed spinal cord, for example, and they could become spinal cord cells and repair the break. [6]

There are two forms of stem cells (to simplify some very complex science). Embryonic stem cells come from embryos, the earliest stage of human development. [7] Adult stem cells, on the other hand, are found in infants, children and adults alike. These cells exist to repair and maintain the human body.

What's happening in stem cell research today

Currently, stem cell research on human subjects uses adult stem cells. Adult stem cells can be harvested from such things as cord blood, bone marrow and many other human cells. The potential for the rejection of implanted cells is also greatly reduced when a patient's stem cells are isolated and then reinserted back into their own body.

Still, some maintain that embryonic stem cells are a great hope for cures, and so research on them continues as well. It's worth noting that the National Institutes of Health, the national medical research agency of the United States government, indicates that no treatments exist as a result of embryonic stem cell research, however, adult stem cell research has already produced successful treatments for human patients. [8]

Those intimately involved with stem cell research admit there's an ethical issue at stake. Dr. James Thomson, the first person to isolate human embryonic stem cells, highlighted the difficulties associated with his decision to begin his research. He told the *New York Times* in 2007 "[i]f human embryonic stem cell research does not make you at least a little bit uncomfortable, you have not thought about it enough." [9]

The possible implications

Does the October 2008 study mean choosing between science and ethics on this topic is a thing of the past? Some experts in ethics and biotechnology say the reprogramming research process could eventually mean a safe source of stems cells for research. [10]

Recent iPS cell research seems in its early stages to provide a positive alternative to embryonic stem cell research. This study points to another avenue for stem cell research, which takes ethical concerns seriously while forging ahead with fruitful scientific endeavours.

Endnotes

[1] Huangfu, D., Osafune, K., Maehr, R., Guo, W., Eijkelenboom, A., Chen, S., Muhlestein, W., Melton, D. A. (October 12, 2008) Induction of pluripotent stem cells from primary human fibroblasts with only *Oct4* and *Sox2*. *Nature Biotechnology*. Article abstract can be retrieved at http://www.nature.com/nbt/journal/vaop/ncurrent/abs/nbt.1502.html

[2] Health Canada. (2008) About Biotechnology, Stem Cells. Retrieved October 20, 2008 at http://www.hc-sc.gc.ca/sr-sr/biotech/about-apropos/stem_cells_souches-eng.php

[3] Takahashi, K. and Yamanaka, S. (2006) Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors. *Cell*, 126, 663-676.

[4] Huangfu, D. et al.

[5] Stem Cell Network. What are stem cells? Retrieved October 20, 2008 at http://www.stemcellnetwork.ca/science.php

[6] Health Canada. (2008) About Biotechnology, Stem Cells. Retrieved October 20, 2008 at http://www.hc-sc.gc.ca/sr-sr/biotech/about-apropos/stem_cells_souches-eng.php

[7] These embryonic cells have the capability of becoming any cell in the human body.

Giesbrecht, G. (Spring/Summer 2006) When Does It All Begin? *IMFC Review*, 20-22. Retrieved October 20, 2008 at http://www.imfcanada.org/article_files/When_does_it_all_begin.pdf

[8] National Institutes of Health, U.S. Department of Health and Human Services. (2008) FAQs. *Stem Cell Information*. Bethesda, MD. Retrieved October 21, 2008 at http://stemcells.nih.gov/info/faqs

[9] Kolata, G. (November 22, 2007) Man Who Helped Start Stem Cell War May End It. *The New York Times.* Retrieved October 20, 2008 at http://www.nytimes.com/2007/11/22/science/22stem.html

[10] See Cohen, C.B., Brandhorst, B.P. (2008) Getting Clear on the Ethics of iPS Cells. Bioethics Forum. Retrieved October 20, 2008 at http://www.thehastingscenter.org/Bioethicsforum/Post.aspx?id=710

For further study of the ethical implications of iPS, see Kaebnick, G. (2008) Embryonic Ethics. Bioethics Forum. Retrieved October 20, 2008 at http://www.thehastingscenter.org/bioethicsforum/post.aspx?id=706 to which Cynthia Cohen and Bruce Brandhorst and Francoise Baylis respond. All articles are found under author name at http://www.thehastingscenter.org/bioethicsforum/byauthor.aspx