What is a stem cell and what is all the fuss?

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The development of a multicellular organism from a fertilized egg depends on regulating the proliferation of cells during development and their differentiation into cells with different specific functions. So what is a stem cell and how does it fit into developmental control strategies? The central property defining a stem cell is the ability to divide, producing two daughter cells, one of which retains the key parental property of being able to divide again. Stem cells are clearly important during the early, proliferative stages of development, but are also found in adults where they help to replace cells that turn over, such as those in blood and skin. Ongoing research is exploring the use of adult stem cells in the treatment of numerous diseases, with one obstacle being the restricted developmental potential of these cells to give rise to different cell types. This obstacle is one reason for the excitement regarding embryonic stem cells, or ES cells.

The most frequently referred to source of ES cells is a small cluster of approximately 100 cells, the inner cell mass in a blastocyst stage. These cells are readily identified and isolated, and can be cultured in an undifferentiated state almost indefinitely. Blastocyst-stage embryos are typically obtained by *in vitro* fertilization, although alternative approaches for generating ES cells from blastocysts, derived by transplantation of nuclei into unfertilized oocytes, are being developed.

An important attribute of ES cells is their ability to generate all of the different cell types in the body, offering enormous potential to treat degenerative diseases. The first human ES cell lines were described in 1998. However, over the last 20 years there is a large body of research on ES cells from other animals, much of this conducted on mice. Indeed, the ability to culture and manipulate ES cells from the mouse has revolutionized the study of mammalian developmental biology. Genetic manipulation of ES cells has allowed the development of mouse models for a large number of human diseases, and studies are underway to explore the feasibility of treating these diseases with stem cell-based therapies.

So where are we now with respect to research on human stem cells? In August 2001 President Bush announced that federal funds could only be used to support research on the different human ES cell lines already available at that time. As it turns out, only a subset of these government-certified cell lines are useful. This has hampered stem cell research in the United States but has not stopped scientists eager to explore the enormous therapeutic potential. Scientists in Korea recently generated a human ES cell line from a blastocyst created by nuclear transplantation. Scientists in the United States have turned to non-federal sources of support for their research, and most recently California passed a proposition that would provide state funds to support embryonic stem cell research. The federal government has traditionally played a leading role in establishing guidelines followed by the entire scientific community. The current government policy is not constructive and is not being followed. It is time to re-examine our position on stem cell research and make well-informed decisions that are acceptable to the public. A useful Web site for those who would like to learn more about stem cell research is maintained by the International Society for Stem Cell Research at *www.isscr.org*.