POLICY FORUM: GENETICS

Please Don't Call It Cloning!

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Scientists rely on a dialect of specialized terminology to communicate precise descriptions of scientific phenomena to each other. In general, that practice has served the community well—novel terms are created when needed to document new findings, behaviors, structures, or principles. The lexicon of science is constantly evolving. Scientists who are fluent in the language of any specific discipline can speak to one another using shorthand expressions from this dialect and can convey an exact understanding of their intended meanings. However, when the scientific shorthand makes its way to the nonscientific public, there is a potential for such meaning to be lost or misunderstood, and for the terminology to become associated with research or applications for which it is inappropriate.

In scientific parlance, cloning is a broadly used, shorthand term that refers to producing a copy of some biological entity—a gene, an organism, a cell—an objective that, in many cases, can be achieved by means other than the technique known as somatic cell nuclear transfer. Bacteria clone themselves by repeated fission. Plants reproduce clonally through asexual means and by vegetative regeneration.

Much confusion has arisen in the public, in that cloning seems to have become almost synonymous with somatic cell nuclear transfer, a procedure that can be used for many different purposes. Only one of these purposes involves an intention to create a clone of the organism (for example, a human). Legislation passed by the House of Representatives and under consideration in the U.S. Senate to ban the cloning of human beings actually proscribes somatic cell nuclear transfer—that is, any procedure in which a human somatic cell nucleus is transferred into an oocyte whose own nucleus has been removed. As Donald Kennedy remarked in a *Science* editorial last year, the legislation would interdict a wide range of experimental procedures that, in the near future, might become both medically useful and morally acceptable (*1*).

A law that would make it illegal to create embryonic stem cells by using somatic cell nuclear transfer would foreclose at least two important avenues of investigation. First, the technique shows promise to overcome the anticipated problem of immune rejection in stem cell–based therapies to replace a patient's diseased or damaged tissue. Creating stem cells with the patient's own nuclear genome might theoretically eliminate tissue rejection (*2*). Second, creating stem cell lines by using the somatic cell nuclei of individuals with heritable diseases offers an unprecedented opportunity to study genetic disorders as they unfold during cellular development.

Both of these research goals have nothing to do with producing a human being. They may be caught up in the proposed legislation in part because of misunderstood scientific jargon—namely, the casual use of the term "therapeutic cloning" to describe stem cells made for research in regenerative medicine using somatic cell nuclear transfer. What is worse, the already blurred distinction between these two very different avenues of investigation has been compounded by the interchangeable use of human cloning with therapeutic cloning by those who suggest that cloning a human being is a "therapeutic" treatment for infertility.

The term cloning, we believe, is properly associated with the ultimate outcome or objective of the research, not the mechanism or techniques used to achieve that objective. The goal of creating a nearly identical genetic copy of a human being is consistent with the term human reproductive cloning, but the goal of creating stem cells for regenerative medicine is not consistent with the term therapeutic cloning. The objective of the latter is not to create a copy of the potential tissue recipient, but rather to make tissue that is genetically compatible with that of the recipient. Although it may have been conceived as a simple term to help lay people distinguish two different applications of somatic cell nuclear transfer, "therapeutic cloning" is conceptually inaccurate and misleading, and should be abandoned.

It is in the interest of the scientific community to clearly articulate the differences between stem cell research and human cloning. Most scientists agree that cloning a human being, aside from the moral or ethical issues, is unsafe under present conditions. A recently released National Academy of Sciences report details the considerable problems observed in the use of somatic cell nuclear transfer for animal reproduction and concludes that cloning of human beings should be prohibited (*3*). But the report also notes the substantial medical and scientific potential of stem cell lines created by using this technique.

More careful use of terminology would help the public and lawmakers sort out the substantial differences between nuclear transplantation and human reproductive cloning (Table). One place to start is to find a more appropriate term for the use of somatic cell nuclear transfer to create stem cells. We propose the term "nuclear transplantation," which captures the concept of the cell nucleus and its genetic material being moved from one cell to another, as well as the nuance of "transplantation," an objective of regenerative medicine.

Legislators attempting to define good public policy regarding human cloning need the scientific community to be clear about the science, and to be clear when they speak to the public about it. Adopting the term nuclear transplantation in relation to stem cell research would be more precise, and it would help to untangle these two very different paths of investigation.

References and Notes

1. D. Kennedy, *Science* **294**, 745 (2001).
2. National Research Council, *Stem Cells and the Future of Regenerative Medicine* (National Academy Press Washington, DC, 2001); available at www.nap.edu/
3. National Research Council, *Scientific and Medical Aspects of Human Reproductive Cloning* (National Academy Press, Washington, DC, 2002); available at www.nap.edu/

THE CRUCIAL DIFFERENCES

	Nuclear transplantation	Human reproductive cloning
End product	Cells growing in a petri dish	Human being
Purpose	To treat a specific disease of tissue degeneration	Replace or duplicate a human
Time frame	A few weeks (growth in culture)	9 months
Surrogate mother needed	No	Yes
Sentient human created	No	Yes
Ethical implications	Similar to all embryonic cell research	Highly complex issues
Medical implications	Similar to any cell-based therapy	Safety and long-term efficacy concerns

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