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CLONING: THE GOOD, THE BAD, THE UGLY

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ABSTRACT

Cloning is the creation of almost genetically identical organism from which the nuclear DNA is taken. The main aim of this paper is to examine the arguments for and against reproductive cloning. It is to show that there is a very strong case for banning human cloning, but also have tried to present the counter-arguments fairly. The popular responses to cloning are grounded in very valid concerns, for example, about relationships between human beings and also between humans and nature. Another clear conclusion is that cloning very starkly exemplifies the clash between a liberal worldview, which tends to see all scientific advances as progress, and a more skeptical, conservative attitude, based on traditional beliefs about human nature. This second view is not confined to religions and political conservatives, and, at least when it comes to cloning, includes the majority of people.

Keywords: Cloning, Nuclear DNA, Liberal, Conservative

INTRODUCTION

Cloning is the creation of almost genetically identical organisms. (For ordinary purposes, clones can be treated as genetically identical to the organisms from which the nuclear DNA is taken. In fact there is a small difference, because the egg also contains a small amount of DNA in mitochondria, small bodies in the main part of the egg. Like organisms produced by sexual reproduction, the clone inherits this DNA only from its mother, not from the nucleus donor. This difference does not affect the ethics of cloning). (Human genetic alert, 1994)

Contrary to popular belief, Dolly (Wilmut I et al., 1997) was not the first cloned sheep. Scientists have been cloning sheep, cattle and other animals since the mid-1980s (Willadsen S.M. 1986). However, in all these early examples, the source of the donor nucleus was taken from an embryo. Embryonic cells have undergone only a few of the many changes in gene expression that occur during the development of an adult organism, so it is less surprising that they can be 're-programmed' to go back to the start of the process. Before Dolly, it was believed impossible to re-programme adult cells. Since Dolly in 1997, using the same or related techniques, scientists have cloned mice, rats, cows, goats, cats, horses and donkeys. While there have been some reports of high efficiency cloning of cows, in most cases the efficiency is still very low. It has not been possible to clone monkeys, dogs or other species. Since 1998 there have been various reports claiming the creation of cloned human embryos. The first published claims were made by South Korean scientists, whose laboratory was eventually closed down by their government. In 2001, scientists from Advanced Cell Technologies, a US biotechnology firm published the only scientific paper to date on cloned human embryos, only one of which grew as far as six cells (Cibelli, J.B., et al. 2001). The company said that this research was for research rather than reproductive purposes. There are unsubstantiated claims that Chinese scientists have cloned human embryos, again for

research purposes. Since 2000 there have been persistent claims by the Italian IVF expert, Professor Severino Antinori, and the US scientist, Panayiotis Zavos, that they are planning to create cloned babies. At the beginning of 2003, a Canadian-based religious cult, The Raelians, also claimed to have succeeded in creating at least five cloned children (CNN), but no proof has been given. It is widely thought that the claims to be doing reproductive cloning are elaborate publicity strategies, similar to those employed by David Rorvik in the 1970s. Reports in 2003 suggest that Ian Wilmut, the scientist who created Dolly, may be about to start creating cloned human embryos for medical research purposes. The modern cloning techniques involving nuclear transfer have been successfully performed on several species. Landmark experiments in chronological order (Wikipedia-cloning):

- Tadpole: (1952) Many scientists questioned whether cloning had actually occurred and unpublished experiments by other labs were not able to reproduce the reported results.
- Carp: (1963) In China, embryologist Tong Dizhou produced the world's first cloned fish by inserting the DNA from a cell of a male carp into an egg from a female carp. He published the findings in a Chinese science journal.
- Mice: (1986) A mouse was the first mammal successfully cloned from an early embryonic cell. Soviet scientists Chaylakhyan, Veprencev, Sviridova, and Nikitin had the mouse "Masha" cloned. Research was published in the magazine "Biofizika" volume XXXII, issue 5 of 1987.
- Sheep: (1996) From early embryonic cells by Steen Willadsen. Megan and Morag cloned from differentiated embryonic cells in June 1995 and Dolly the sheep from a somatic cell in 1997.
- Rhesus Monkey: Tetra (January 2000) from embryo splitting
- Gaur: (2001) was the first endangered species cloned.
- Cattle: Alpha and Beta (males, 2001) and (2005) Brazil
- Cat: CopyCat "CC" (female, late 2001), Little Nicky, 2004, was the first cat cloned for commercial reasons
- Dog: Snuppy, a male Afghan hound was the first cloned dog (2005).
- Rat: Ralph, the first cloned rat (2003)
- Mule: Idaho Gem, a john mule born 4 May 2003, was the first horse-family clone.
- Horse: Prometea, a Haflinger female born 28 May 2003, was the first horse clone.
- Water Buffalo: Samrupa was the first cloned water buffalo. It was born on February 6, 2009, at India's Karnal National Diary Research Institute but died five days later due to lung infection.
- Pyrenean Ibex (2009) was the first extinct animal (extinct 2000) to be cloned back to life; the clone lived for seven minutes before dying of lung defects.
- Camel: (2009) Injaz, is the first cloned camel.

Steps in cloning

The seven steps to a clone are, in theory, relatively simple.

- First, you need an unfertilized egg -- a human one if a human is to be cloned, a sheep's egg if it is to be a Dolly.
- Second, you have to remove the DNA sequence -- that is to say, the set of genetic instructions for building every part of the adult organism -- from the nucleus of the egg. The Scottish doctors simply sucked it out with a pipette.
- Third, you need another cell, to fuse with the egg. That cell could come from anywhere in the body of the human or animal to be cloned, because practically every cell contains the complete set of chemical instructions needed for creating that particular individual.
- Step four is the insertion of that single cell into the egg.
- Step five requires the fusion of the new cell and the egg. This is the crucial step that "switches on" the cell's DNA -- the 30,000 to 40,000 genes which dictate the building of a new body -- and persuades it to start the manufacture of an embryo. The process normally requires the application of a small electrical current. "That's what happened in the creation of Dolly," said Dr. Griffin. "It mimics the changes that happen when sperm fertilizes an egg."
- The sixth step is to implant the egg, now flush with genetic material, into the womb of a sheep -- or woman. If that implantation is successful, the egg will divide and develop, so that after nine months, in the case of a human, step seven occurs: the birth of a clone.

The process can theoretically be repeated many times to produce a whole series of genetically identical clones. Cloning has a success rate of about 1 percent or less for example 277 eggs was implanted to get one cloned sheep. Other laboratories that have cloned mice and pigs report similarly high rates of failure.

THE GOOD, THE BAD AND THE UGLY OF CLONING

Cloning is a highly controversial topic these days. Many scientists consider cloning a vital step in the advancement of medicine. And then there are many others that are opposed to cloning because of the moral ramifications. The main purpose behind developing animal cloning techniques is to facilitate the genetic engineering of animals. Traditionally, new DNA for modifying animal genes can be inserted only into very young embryos, usually at the 1- or 2-cell stage. But whether these genes are incorporated into the embryos is determined purely by chance. Thus, the success rate is very low and the procedure time consuming. With cloning techniques, the DNA is added to dish-cultured cells by the thousands or millions. It then becomes feasible to detect which cells have incorporated the inserted DNA. Then, technicians can transfer the nucleus of such cells to enucleated egg cells to produce embryos, which contain modified DNA.

Therefore, animal cloning would also interest some food and drug industries if it could result in consistently high-quality, marketable products such as milk or meat or, with genetic engineering, if it could generate therapeutic proteins from goat or cow milk or chicken egg whites (commonly called "pharming"), or even pig organs transplantable to humans without immune rejections (I. Wilmut 1998). One biotech company, PPL Therapeutics, Inc., working

with the Roslin Institute, cloned "Polly" in 1997, a sheep produced from an embryonic cell that had been genetically transformed. Polly secretes a human blood-clotting protein in her milk, useful for treating haemophilia. International standards for regulating such a technique have not been established, and various non-human cloning efforts have sprouted here and there.

News of successfully cloned animals has caught public attention, but scientists are far from perfectly controlling the results. Success rates for producing cloned embryos depend on the species and types of cells used, but they remain generally very low. Even with a successful birth, a wide range of abnormalities and defects are observed in cloned animals, among them, one known as Large Offspring Syndrome (LOS). Cloned animals are often too large for normal delivery, and the placenta has grown abnormally. Such defects are not yet fully explained, but one possibility is that a nucleus removed from a somatic cell may not be properly reprogrammed to develop into a normal offspring. According to some, such cloning technique flaws will be resolved as research progresses. Others argue that cloning a perfectly healthy offspring is ultimately impossible and that even apparently healthy cloned animals may contain genetic defects.

Direct advantages

Transgenic clones can be directly beneficial to humans, other animals, and agriculture in additional ways. They may be developed for tissue and organ transplantation. Although not yet a reality, there is promise that large animals can be genetically designed and cloned so that their tissues and organs will not trigger immunological responses in the recipient and cause them to be rejected. Recently, muscle rigidity and tremors in parkinsonian rats were improved by transplanting cloned transgenic bovine neurons into their brains. This research, called xenotransplantation, is one of the many avenues being pursued in an attempt to alleviate the desperate shortage of human tissues for transplantation (W. M.Zawada et al., 1998). Domestic animals can be genetically designed to express a certain human disease and therefore serve as models for the study and treatment of human illnesses. Although many mouse models of human diseases are available today, such models in large domestic animals physiologically more similar to humans are sparse and critically needed. Somatic cell nuclear transfer might help preserve endangered species such as pandas that have low reproductive rates.

Indirect advantages

Two other significant gains from clones are worth mentioning. First, inducing cancer cells to differentiate is a useful type of therapy. We know that many types of cancer cells are less specialized than their normal counterparts. For this reason investigators suspected that the precursors of cancer cells could be immature cells or stem cells that fail to complete differentiation. If this is so, then by using information gained from nuclear transfer technology, we may be able to induce the cells to mature and stop making tumors. Previous studies have demonstrated that we can control at least some cancer cells by using the differentiation process. Second, aged cell nuclei can be rejuvenated. People and other

organisms change as they age. Environmental insults and diseases cause these antichanges; others are intrinsic to the organism. Studies using cell culture have shown that body cells grow and divide normally in culture for awhile, but eventually stop dividing, become senescent, and die. An exception was seen in aged frog red blood cell nuclei (human red blood cells lack nuclei): After their transfer into enucleated oocytes, frog red blood cell nuclei were rejuvenated. They carried out the formation of tadpoles that survived almost a third of the way to metamorphosis. The oocyte cytoplasm contains an abundance of chemicals that promote DNA synthesis and cell division after normal fertilization. We believe that these substances also rejuvenate aged cell nuclei and turn non-cycling frog red blood cells into active ones. If we could isolate these substances, we might be able to alleviate—or reverse—senescence.

Perils

Although Dolly, mice, and calves have been the first animals cloned from adult cells, the low efficiency in producing them negates attempts to clone humans. The Dolly experiment began with 434 attempts to fuse a mammary gland cell to an oocyte, and ended with only a 0.2% success rate; the remaining attempts resulted in death either during fusion or in various developmental stages. Moreover, the 1-2% success rate with mouse and 1-5% with calf cloningfrom adult cells are equally low. And high frequency of fetal (approximately 60%) and neonatal (approximately 50%) deaths are common. In a real sense, cloning is a roulette game. Even if cloning from adult cells did become efficient, there still would be serious hazards.

- Donor cells could suffer mutations from radiation, chemicals, aging, and/or errors in DNA replication during the lifetime of the donor, which would be transferred to the clone.
- Mutations could arise in donor cells during cell culture, not an unusual event, and there is no way of distinguishing a normal donor cell from a mutant one.
- The embryo may be a mosaic of cells, some with apparently normal chromosomes and others with abnormal ones. So far, the prospects for identifying an abnormal embryo prior to transfer to the uterus are poor.

And there are other scientific concerns:

- the life span of the clone is unknown, as is
- the compatibility between the genetic products in the cytoplasm of the oocyte and the donor cell, and
- during the normal process of sexual reproduction, there is a natural selection of the fittest germ cells in fertilization. Although this process is not perfect (i.e., it fails to eliminate some harmful mutations), it does not exist in cloning.

So we can see that it is unlikely that cloning of a human being from any donor age will happen any time soon. Indeed, the scientific community was so strongly opposed to the production of a human being by cloning techniques that the Federation of American Societies for Experimental Biology and other professional organizations representing more than 67,000

scientists have issued a voluntary moratorium against such an act. The groups endorsing this position included those scientists most capable of performing this type of work.

Although these scientists believe that cloning a human being is unethical and reprehensible, they are still concerned that some of the anti changes cloning legislation designed to prevent the cloning of a human being contains language that also will prohibit vital biomedical research that can lead to the repair of diseased and damaged human tissues and organs, and to possible treatments and cures for diabetes, cancer, Parkinson's disease, and other neurodegenerative diseases.

Other nations have found a successful balance between these two concerns. Many European countries have outlawed attempts to clone humans, while preserving the freedom of scientists pursuing cloning studies in non-human organisms because of the potential benefits. In the United States, the National Bioethics Advisory Committee recommended an "imposed period of time in which no attempt is made to create a child using somatic cell nuclear transfer." In their 1997 statement, the committee cautioned, "Any regulatory or legislative actions undertaken to effect the foregoing prohibition on creating a child by somatic cell nuclear transfer should be carefully written so as not to interfere with other important areas of scientific research."

Cloning and human nature

The possibility of human cloning also raises, in a very radical way, old and very fundamental questions about human nature. Is human nature relatively fixed by biology, or can we adapt to new and different ways of reproduction and family arrangements without damaging ourselves? Each new development in reproductive technology has raised this question, which has tended to be manifested in a 'moral debate' about sexuality, the family and society. This argument, which pits religious conservatives against a progressive lobby of liberals, (most) feminists and scientists and doctors, periodically erupts onto national political agendas.

Conservatives tend to argue that biology dictates kinship patterns, and that these are part of the fundamental basis of human nature. Cloning certainly radically disrupts kinship patterns and conventional relationships between biological and social parenthood. For example, an adult parenting a clone of him/herself is parenting his/her genetic twin, and it is not difficult to see how this could lead to psychological difficulties for both parent and child. The American bioethicist, Leon Kass argues that the social identities of parent and child, and the relationships between, them are created by and grounded in the rules of natural sexual reproduction, and in the genetic relationships that it produces (Kass, L., 1997). He sees the biological grounding as essential to give individuals clear identities, as to which family they belong to, and to ensure the love and protection of children by their parents. Kass argues that cloning fits perfectly within existing social trends of separation of sex from reproduction, of atomisation of the family, of individualism (verging into narcissism), and of consumerism: 'The clone is the ultimate single-parent child'. Using similar arguments to those about IVF,

the defenders of cloning argue that infertile parents who have had to expend great effort and expense to produce a child will love it all the more.

Some bioethicists, such as Joseph Fletcher, who view the essence of human nature to be to manipulate nature through technology, go further. Fletcher argues that artificial and eugenically controlled reproduction (including cloning is superior to and 'more human 'than natural reproduction (Fletcher, J 1974). Likewise, some of the more enthusiastic cloning advocates even claim that a more rationally and scientifically controlled, planned parenthood, is superior to natural reproduction and is likely to produce better parent-child relationships (Pence G, 1998). Such liberals tend to deny the concept of a fixed human nature or human condition based on either biology or anthropology. For these commentators, if there is any human nature it is to be selfcreating, rational species with no fixed limits (Stephens, P. 1999). It is not difficult to see how this ideology can be used to legitimate the ongoing project of rationalization of nature, including human nature, and to reject the idea of natural limits to such a process.

CONCLUSION

Discussions of how to regulate cloning techniques must involve both experts from various fields and the lay public since the issues of reproduction and the moral status of embryos touch on the very meaning of "life" for humans. Concepts of life, values and rules concerning reproduction have developed in each society and are deeply embedded in culture, tradition and religious teachings. However, rapid developments in genetics and biotechnology easily transcend national borders and sometimes challenge such values. Thus, the urgent need emerges for international harmonization and regulation on human cloning issues. Understandably, to respect each society, differing national rules may govern the application of certain technologies. But the fundamental value of "human dignity" remains a touchstone to guide us all in the quest for answers.

Cloning is only one of many discoveries in which society will have to choose which of its applications are good, bad or ugly.

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