Human cloning

Fact or fiction

Mandy D. Abushama, *MRCOG, DFFP,* ***Badreldeen I. Ahmed,*** *MRCOG, MD.*

For as long as twins have been born, humankind has tinkered with the idea of cloning. However, the idea may soon become a reality. Cloning is the production of one or more individual plants or animals that are genetically identical to another plant, animal or even human. With the exception of the sperm and egg, every cell in the body contains all of the genetic material in its DNA to theoretically create an exact clone of the original body. But cells have been bio-chemically programmed to perform limited functions.[1] The other functions are turned off. Most scientists had believed that such differentiated cells could not be reprogrammed to be capable of behaving as a fertilized egg. The idea behind cloning is reactivating these differentiated cells to behave such as germ cells that have been fertilized.

Scientists in the 1950's, 1960's and 1970's demonstrated that they were able to clone frog tadpoles from frog embryonic cells using nuclear transfer. Later, in the 1980's, scientists created clones of mammals by splitting embryos in a process called "artificial twinning" or by nuclear transfer using embryonic cells.[2] A major breakthrough in animal cloning occurred in 1997 when Wilmut et al[3] at the Roslin Institute in Scotland cloned a sheep (Dolly) using genetic material from a non-embryonic cell, an adult mammary gland cell. It was fused with a sheep ovum, which had its nucleus, removed. The "fertilized" cell was then stimulated with an electric pulse. Out of 277 attempts at cell fusion, only 29 began to divide. These were all implanted in ewes. Thirteen became pregnant but only one lamb was born. To date, sheep,[4] cattle,[5] mice,[6,7] pigs,[8,9] goats,[10] cats,[11] and rabbits[12] have all been cloned from adult cells using nuclear transfer.

Somatic cell nuclear transfer, which refers to the transfer of the nucleus from a somatic cell to an egg cell. A somatic cell is any cell of the body other than a germ (reproductive) cell. An example of a somatic cell would be a blood cell, heart cell, skin cell, and so forth. The egg with its donated nucleus is then nurtured and divides until it becomes an embryo. The embryo is then placed inside a surrogate mother and develops inside the surrogate. There are 2 variations of this method. They are the Roslin technique and the Honolulu technique.

Roslin technique. In this process, somatic cells (with nuclei in tact) are allowed to grow and divide. This is then fused to an egg cell from which the nucleus was removed using an electrical pulse. The resulting embryo is then implanted in the surrogate mother. The researchers used this method to create the sheep.

Honolulu technique. In the Honolulu technique, the nucleus from a somatic cell is removed and injected into an egg that has had its nucleus removed. The egg is bathed in a chemical solution and cultured. The developing embryo is then implanted into a surrogate and allowed to develop.

It is important to note that in all of these techniques the resulting offspring will be genetically identical to the donor and not the surrogate, unless the donated nucleus is taken from a somatic cell of the surrogate.

Cloning in humans. The first publicly announced human cloning was carried out by Robert J. Stillman and his team at the George Washington Medical Centre in Washington D.C. They took 17 genetically flawed human embryos, which would have died within days no matter how they were treated. They were derived from an ovum that had been fertilized by 2 sperm. This resulted in an extra set of chromosomes, which doomed the ovum's future. None could have developed into a fetus. These ovum were successfully split in October 1994, each producing one or more clones.

In April 2002, Dr. Severino Antinori (an Italian Obstetrician and Gynecologist) announced that a woman

From the Women's Hospital, Hamad Corporation, Doha, *Qatar*.

Address correspondence and reprint request to: Dr. Mandy D. Abushama, Consultant Community Obstetrician & Gynecologist, Women's Hospital, Hamad Corporation, PO Box 3050, Doha, *Qatar*. Tel. +974 4393956. Fax. +974 4393389. E-mail: mdabushama@hotmail.com

who joined his program for infertile couples is now 8 weeks pregnant with a fetus derived by human reproductive cloning.[13] By the end of 2002 the Raelians (a sect who belief humans came from outer space) claimed to have created "Eve", the daughter of a 31-year-old American woman.

In January 21, 2003 the "embryonic cell fusion machines" said to have been used to produce the first clone of a human being went on display in London. It was developed by the sect's scientific arm, Clonaid. There still remain serious questions as to whether all this was a hoax. To date, scientists have not been able to genetically fingerprint mother and daughter to confirm the success of the process. This leaves claims of such bodies such as the Raelians, Clonaid and Dr. Antonori unsubstantiated and unaccepted by the bulk of the scientific community.

Expected benefits of cloning. 1. Scientists are attempting to create transgenic pigs, which have human genes. Their heart, liver or kidneys might be useable as organ transplants in humans.[14] 2. Researchers have produced transgenic animals. These are genetically altered, typically in order to produce human hormones or proteins in its milk. These materials can be separated from the milk and used to heal humans.[15] 3. Cloning could produce a reservoir of "spare parts". Fertilized ova could be cloned into multiple zygotes; one could be implanted in the woman and allowed to develop into a normal baby; the other zygotes could be frozen for future use. In the event that the child required a bone marrow transplant, one of the zygotes could be taken out of storage, implanted, allowed to mature to a baby and then contribute some of its spare bone marrow to its (earlier) identical twin. Bone marrow can be harvested from a person without injuring them.

Some individuals and groups have expressed concerns on the adverse effects of embryo cloning in humans, and question its morality.

Concerns regarding human cloning. 1. The genetic screening test when using cloning as a mode of pre-implantation diagnosis could also be used to eliminate zygotes of a particular gender, without requiring a later abortion. 2. There is always the possibility of injuring or killing embryos. Most pro-life supporters believe that an embryo is a human person. 3. Most cloned animals do not survive to birth or die soon after.[16]

The morality of cloning. The ethics of cloning have been hotly debated ever since the sheep cloned from the genetic material of an adult sheep, was born in Scotland in 1997. Two types of cloning are being discussed in relation to humans: therapeutic cloning and reproductive cloning. 1. Reproductive cloning - to allow for a genetic twin, like a born person. It's probably going to be for the rich and famous. 2. Therapeutic cloning, where an adult undergoes a procedure to duplicate cells in order to stave off disease, illness, or the effects from sudden and serious injury. In diseases such as Alzheimer's or the need for a bone marrow transplant a clone is formed and healthy cells taken from it for transplant before the embryo is destroyed.[17] There is no federal law banning cloning in the United States, but several states have passed their own laws to ban the practice. The US food administration (FDA) has also said that anyone in the United States attempting human cloning must first get its permission. In Japan, human cloning is a crime that is punishable by up to 10 years in prison. England has allowed cloning human embryos, but is working to pass legislation to stop total human cloning.

We believe that cloning, like many new technologies, has great potential to be used for good, but also has the potential to be misused.

References

1. Bohlin R. The Little Lamb That Made a Monkey of Us All - Can Humans be Cloned Like Sheep? 1997. Available from: URL: http://www.probe.org/docs/lamclo.html
2. Early scientific attempts at cloning. Available from: URL: http://www.worldbook.com
3. Wilmut I, Schnieke AE, McWhir J, Kind AJ, Campbell KH. Viable offspring derived from fetal and adult mammalian cells. ***Nature*** 1997; 385: 810-813.
4. Cibelli JB, Stice SL, Golueke PJ, Kane JJ, Jerry J, Blackwell C, et al. Cloned transgenic calves produced from nonquiescent fetal fibroblasts. ***Science*** 1998; 280: 1256-1258.
5. Kato Y, Tani T, Tsunoda Y. Cloning of calves from various somatic cell types of male and female adult, newborn, and fetal cows. ***J Reprod Fertil*** 2000; 120: 231-237.
6. Wakayama T, Perry AC, Zuccotti M, Johnson KR, Yanagimachi R. Full-term development of mice from enucleated oocytes injected with cumulus cell nuclei. ***Nature*** 1998; 394: 369-374.
7. Ogura A, Inoue K, Takano K, Wakayama T, Yanagimachi R. Birth of mice after nuclear transfer by electrofusion using tail tip cells. ***Mol Reprod Dev*** 2000; 57: 55-59.
8. Polejaeva IA, Chen SH, Vaught TD, Page RL, Mullins J, Ball S, et al. Cloned pigs produced by nulear transfer from adult somatic cells. ***Nature*** 2000; 407: 86-90.
9. Onishi A, Iwamoto M, Akita T, Mikawa S, Takeda T, T Awata, H Hanada, A C Perry. Pig cloning by microinjection of fetal fibroblast nuclei. ***Science*** 2000; 289: 1188-1190.
10. Baguisi A, Behboodi E, Melican DT, Pollock JS, Destrempes MM, Cammuso C et al. Production of goats by somatic cell nuclear transfer. ***Nat Biotechnol*** 1999; 17: 456-461.
11. Shin T, Kraemer D, Pryor J, Liu L, Rugila J, Howe L et al. A cat cloned by nuclear transplantation. ***Nature*** 2002; 415: 859.
12. Chesne P, Adenot PG, Viglietta C, Baratte M, Boulanger L, Renard JP. Cloned rabbits produced by nuclear transfer from adult somatic cells. ***Nat Biotechnol*** 2002; 20: 366-369.
13. Yong E, Carrington D. Cloning pregnancy clain prompts outrage. Available from: URL: http://www.newscientist.com/nsplus/insight/clone/html
14. Tangley L. The perils and promise of Xena (clones could provide successful pig-to-human transplants. ***US News World Rep*** 2000; 129: 48.
15. Wilmut I. Cloning For Medicine: Now that genetically modified and copied mammals are a reality, biomedical researchers are starting to develop imaginative ways to use this technology. Available from: URL: http://www.sciam.com
16. Pennisi E, Vogel G. Clones: a hard act to follow. ***Science*** 2000; 288: 1722-1726.
17. Sarah M. The ethics of cloning and human embryo research. ***Princet J Bioeth*** 2002; 5: 25-36.