

The first primates cloned using „Dolly sheep” method.

Two crab-eating macaques (*Macaca fascicularis*), named Zhong Zhong and Hua Hua, are genetically identical. Cloning of primates by somatic cell nuclear transfer method has been successfully completed, as the scientists from the Chinese Academy of Sciences say in the Cell magazine. The monkeys birth is one of the biggest scientific breakthroughs. Are human next for being cloned?

Since 1996, when the famous Dolly sheep came to the world, scientists have successfully used the method of nuclear transfer to clone pigs, dogs, cats, mice and many other species. However, it has never been possible to clone non-human primates this way. Until now. Molecular biologists of Chinese Academy of Sciences Institute of Neuroscience used the Somatic Cell Nuclear Transfer (SCNT) method, which resulted in two full-clone clones of the same macaque monkey. Zhong Zhong was born to a surrogate mother at the end of November. His name comes from the word meaning "Chinese nation". Hua Hua was born a week later.

The sence of the method is to remove the nucleus from the isolated oocyte and replace it with the nucleus extracted from the fibroblasts taken from the other organism. Next step is to "cheat" the ova cell with the electric impulse, so it "thinks" it has been fertilized. Then, the embryo is implanted in surrogate, that will carry it until delivery. Of course, baby is a genetic copy of the nucleus donor.

Zhong Zhong and Hua Hua are not the first monkeys that have been already copied. But the organisms that have been created so far, have not been clones in the narrowest sense of the word. They were created as a result of the division of the embryo in the first phase of its development. Thus in a manner similar to the natural formation of monozygotic twins. Such method is not very effective. It is possible to create a maximum of 4 cloned organisms in that way. It seriously limits the scientific benefit in comparison to the method used by the team of Dr. Qiang Sun, Director of the Center for General Research at the Institute of Neurophysiology of the Chinese Academy of Sciences in Shanghai. The SCNT method, which he had used with his colleagues, theoretically allows to create any number of genetically identical units.

The most important barrier in primate cloning has been the successful implantation of the embryo in the uterine mucosa. Scientists from Shanghai have managed to overcome it. Accelerating the transfer of the donor nucleus to the empty oocyte was the key to success. It significantly reduced the likelihood that further development would go in the wrong direction. Researchers also developed special biocatalysts that protect the DNA against damage factors and force the ova to cell division after donor nucleus insertion. They also found that fetal cells should be taken, not those from an adult monkey organism, in order to increase the chances of success of the project. However, the effectiveness of the method still applies to a small number of cases. Chinese researchers undertook

the implantation of 79 embryos obtained by SCNT with 21 surrogates. Only six of them successfully implanted and the animals became pregnant. Most of fetuses survived for a few days. Only two clones were born alive. There were Zhong Zhong and Hua Hua. Scientists predict that they will be closely watching their grown, which is completely normal so far. It is possible that the macaques will receive new cloned cousins in the next few months.

The success of the primate cloning procedure raises obvious questions about the next step in cloning area. Chinese biologists argue, that it opens us the way to the future. It is anticipated that it would be possible to conduct many genetic researches on cloned animal models with DNA code closely similar to human, thanks to this breakthrough. For example, this allows for breeding of genetically identical primates with precisely modified pathogenic genes to imitate formation of specific disease entities. This will pave the way for understanding of pathogenesis and testing of different therapeutic methods for many human genetic diseases. Scientists hope that their discovery will contribute to finding new methods of the therapy for cancer, neurodegenerative diseases, metabolic and immunological disorders. For sure, it will allow to perform further observations to the gene manipulation effects.

The birth of Zhong Zhong and Hua Hua revive the social discussion about the ethical aspects of genetical research and experiments. Does a successful monkey cloning procedure mean that the world is approaching human cloning? International law remains unambiguous and strictly prohibits human cloning. However, this has only worked in the theoretical sphere, until now. Can the cloning of the first primates result in a theoretical approach no longer sufficient?

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