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Therapeutic cloning and stem cells

by Phil Jones

Taking the genetic material from a human adult's cell, placing it inside a human egg and allowing it to grow could lead to the birth of a human clone. If technicians want to they could dismantle the developing embryo after a few days and gather cells. These cells have the potential of being used to generate tissue cultures and maybe even organs that could treat diseases in either the original donor adult or others. Many people, however, are anxious that this would be an unethical use of human embryos and claim that alternative approaches need to be explored.

'Cloning people is wrong'. This is a common gut reaction to the idea of producing identical copies of human beings. It's easy to conjure up images of designer soldiers or multiple copies of despotic rulers as in Ira Levin's *Boys from Brazil*.

Listen further and you will find that the advocates of cloning are not suggesting we produce hundreds of copies of the perfect soldier. Instead, they claim that cloning will give hope to many people suffering from some of the most terrible human diseases.

Rather than producing whole people, they say that cloning techniques should be applied to generate human tissues from highly versatile stem cells that can be 'harvested' from specially manipulated human embryos. These could then be used to repair damaged brains, livers or other organs, giving hope to people with Parkinson's disease, liver failure and other distressing conditions.

When confronted by people who have incurable diseases, many become convinced that experiments in so called 'therapeutic cloning' may be worthwhile to give hope to those who face such a bleak future.

A report presented to Parliament in August 2000 recommended that the government amends the Human Fertilisation and Embryology Act 1990 to allow research into therapeutic techniques that employs stems cells derived from human embryos. The Government accepts this recommendation, partly because it believes that there will be considerable prestige if Britain is at the forefront of the new technology.

This response is in marked contrast to the September 2000 resolution in the European Parliament which called for all member states to 'introduce binding norms that prohibit all forms of research on any type of human cloning and provide penal sanctions for any violation'.

To investigate these differing views we need to address the following questions: Why do some people want to use cloning to make human 'spare parts'? What ethical questions does this technique raise? Are there any alternative approaches that could achieve similar results?

Conventional limitations

Many brain, liver or kidney diseases destroy the sufferer's quality of life and ultimately kill them. Sometimes a new organ can be transplanted from a donor who has just died. In a few cases a living donor can give a 'spare' kidney or bone marrow without becoming ill themselves.

There is, however, a severe shortage of donated human tissues and organs. The news frequently highlights stories of people dying while waiting for an organ, and indeed there are thousands of people on organ transplant waiting lists.

In other cases, such as brain disease, it is not feasible to transplant whole organs.

Even when transplantation is possible it has major problems. In particular, the recipient's immune system rejects all tissues from another person unless donor and recipient share an identical immune 'bar code', known as an HLA type.

An organ from an identical twin is the best solution to the rejection problem because its HLA type will

match perfectly—the recipient is identical to the donor. Some people manage to find a relative who is a close enough match to be a living donor, but many patients wait for years for an organ to be found from an unrelated donor.

Even if a suitable organ is found, these patients have to take powerful drugs to suppress their immune systems and stop rejection of their replacement organ. This can leave them prone to infections and cancer.

Repairing organs

Stem cells are a vital part of the body's make-up. These cells can grow into one or more different types of tissue and are involved in the normal maintenance of the body and tissue repair after damage.

Early embryos contain embryonic stem cells that could potentially form almost any tissue of the body if they are removed and grown in a laboratory under the right conditions.

Cloning technology offers the possibility of building embryonic stem cells with HLA types that match specific patients, thus solving the rejection problem that hampers organ transplants. Researchers hope to develop techniques that will cause these cells to grow into specific types of tissue. The result could be the ability to grow cells for specific patients that could be used to repair a damaged organ, or help in its repair. This could remove the need for transplant surgery and raises the prospect of repairing organs like the brain, which cannot be transplanted.

Ethical perspectives

Developing treatments for terrible illnesses is undoubtedly a worthy aim. Both patient support-groups and research scientists are keen to get approval to proceed with research on cloning and human embryonic stem cells with the goal of repairing damaged tissues.

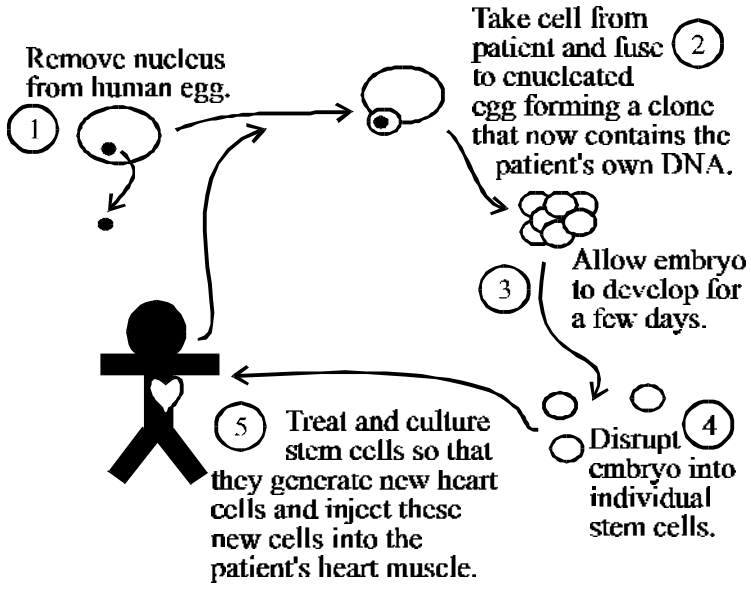
However, at least two important questions need to be addressed before deciding whether to approve of research into human cloning and embryonic stem cell technology. First, can we accept the cloning of humans, and secondly, should we protect early human embryos from techniques that will destroy them?

Cloning humans

Genetically identical individuals do occur naturally. So in some ways identical twins are equivalent to clones because they share the same genetic make-up.

Scientists can now clone mammals. Their first attempts at cloning were restricted to using genetic material (DNA) from embryos, but the birth of Dolly the sheep in July 1996 showed that

Producing 'spare part' tissues using cloning techniques to generate embryonic stem cells



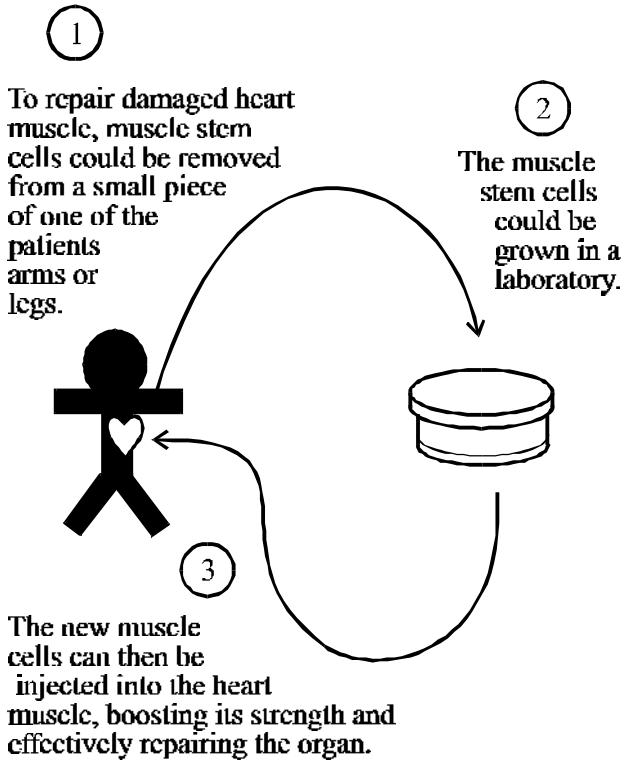
Stem cells prepared from human embryos created by cloning techniques can be used to overcome the problems of immune rejection that hamper transplanted organs. In this case a patient with a heart muscle problem receives heart muscle cells to repair the damage. In reality a vast amount of research would be needed to make this type of treatment possible.

clones could be generated by using the DNA from adult mammalian cells. This raises the possibility that researchers could create clones of children and adults.

Cloning humans is fraught with ethical problems. Normally a child is the fruit of a loving relationship between two parents to whom, as a consequence, they are genetically related. Cloning makes potentially possible the manufacturing of children from a clone donor. This is termed Reproductive Cloning and will be the subject of a future CMF File.

The UK Government plans to ban the growing of cloned human embryos beyond 14 days. This would prevent reproductive cloning, but still permit the cloning techniques that generate human embryos in order to produce embryonic stem cells for tissue repair.

Using a person's own stem cells to repair damaged tissue



The use of adult stem cells to repair damaged tissue, in this case the heart. This technique is much simpler than the cloning of human embryo stem cells and avoids the ethical problems. In October 2000 it was reported that this technique was successful in treating a patient who had heart damage following several heart attacks.

Experimentation on human embryos

To develop embryo-derived stem cell techniques will require the use of hundreds or thousands of human embryos. The embryos will be grown in dishes before dismantling them into individual cells. Although some of the embryo's cells live on, the embryo itself is destroyed in the procedure.

One source of embryos for research would be the 'spare embryos' generated in fertility treatments. There are unlikely to be enough 'spare' embryos, so researchers would need people to donate eggs and sperm so that they could create embryos solely for research to develop this technology.

Something or someone?

A key issue in deciding our view on the use of human embryos is whether we view the embryo as merely a 'thing', a potential person, or actual person.

If we believe that to be a person we have to have a certain set of abilities, for example, be able to relate to other people, be able to feel, be able to communicate, the question seems straightforward. The early embryo has none of these abilities and is a 'thing'. It is not a person. People believing this see no ethical problems with experimenting on embryos or using them to generate stem cells.

Basing your view of what a person is on their abilities has wider implications than just determining the status of an embryo. It soon starts to encroach on the way that we value fetuses, newborn babies or people with disabilities.

Other people, including some Christians, believe that to be a person we need to have the ability to relate, talk, or whatever, but still feel uneasy about embryo experiments. They are concerned

that although the early embryo lacks these abilities, it is clearly human and has the potential to acquire a full range of abilities if allowed to implant in a woman's womb and develop into a baby. They believe that such potential people should be treated with special respect.

Another view is that being a person is a gift, and does not depend on having any particular abilities—or for that matter any abilities at all. Christians believe that humans are special because they are special to God, who knows each of us personally. This idea implies that we are all of equal value no matter what abilities we have or do not have. Personhood being a gift implies that we can not look at any embryos and say with certainty that they are not persons in God's sight.

Because God values each of us so highly we have a duty to protect everyone against exploitation, especially the weak and vulnerable who cannot defend themselves. If embryos may be people we can not approve of their destruction in the cause of research.

There is no scientific test that can help us decide whether embryos are things, potential persons or full persons. But if there is any possibility that embryos could be persons then we have a duty to protect them from experiments that would destroy them.

Alternative approaches

Given that research on embryonic stem cells present so many ethical dilemmas, it is worth looking for alternative approaches. Stem cells that are able to regenerate tissues are not only found in embryos. Adults also have stem cells in many tissues, which replace the cells that are lost from that tissue throughout life. For example the millions of cells that are lost every day from the blood system are replaced by blood stem cells.

It has recently been discovered that these adult type stem cells also have the potential to form other tissues. For example, nervous system stem cells can be turned into cells that make blood cells, and adult blood stem cells can make liver cells.

Adult stem cells, taken from an unaffected tissue in a patient could be grown in the laboratory and given back to the patient. Because these cells come from the patient's own body there would be no problem with immune rejection.

There is no need to use human embryos or cloning techniques with this approach. It has recently been shown that stem cells from a patient's leg muscle can be cultured and injected back into the heart of the same patient. The injected cells repaired heart muscle that had been destroyed in a heart attack. Blood stem cells are routinely taken from patients to repair their blood system if this is damaged during cancer treatments. Stem cells have also been found in tissues like the nervous system, giving hope that research into adult stem cells may help people with certain brain diseases.

It needs to be stressed that it may not be possible to repair all body tissues, especially if the disease that caused the damage in the first place is still active or has caused very severe damage to an organ. The routine use of stem cell technology for treatment of most diseases remains some years away.

Using adult-derived stem cells avoids many of the ethical problems associated with embryonic cells. The patient's own cells are being reprogrammed to become another tissue type, and no one is harmed in the process.

Conclusion

Recent advances in cell biology have made the repair of tissues damaged by disease, using stem cells, an exciting possibility. However, a great deal of research will need to be done in order to develop either embryonic or adult stem cell treatments to the stage where they may be of benefit to patients.

Whether the development of embryonic stem cell treatment using cloning is ethically acceptable depends on whether embryos are persons. Given that embryonic stem cell research is at best ethically questionable, it seems better to err on the side of caution and focus research on developing the use of techniques that use a patient's own stem cells.

Further Reading

Weissman, I. L. (2000) Translating stem and progenitor cell biology to the clinic: barriers and opportunities. Science; ***287****: 1442-6.*

McKay, R. (2000) Stem cells – hype and hope. Nature; ***406****: 361-4.*

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