Stem Cells in a Nutshell

A guide for journalists prepared by the AusSMC

This is a resource for news reporters and is part of the *Science in a Nutshell* series produced by the AusSMC. It is a straightforward explanation of stem cells and includes an appreciation of some of the contextual issues associated with it.

If you would like to know more about stem cells or talk to an expert, contact the AusSMC by email (info@aussmc.org) or call us on 08 8207 7415.

What are stem cells?

Stem cells are the human body's master cells. They are found in the embryo, which is the earliest stages of development following fertilisation, but before implantation. They are also found in cord blood, in the fetus and infant, and in some adult tissues. Stem cells play a critical role in normal growth and development by providing new cells for growth and for replacing and repairing used and damaged tissues. Medical researchers believe stem cell research has the potential to change the way human disease is treated, by allowing stem cells to be used to repair specific tissues or to grow organs.

What are adult stem cells?

These are a type of stem cell found in organs and tissues in babies, children and adults. Most adult stem cells have, so far, been shown to replenish the particular organ or tissue from which it is derived and are more *specialised* than the *unspecialised* clump of cells found in an early embryo. For instance the bone marrow stem cell replenishes all the different types of cells of the blood, but has not been shown to be able to replenish cells in the liver or brain. The term “adult stem cell” is misleading, and is used to distinguish such cells (which are often from babies or even the fetus) from “embryonic stem cells”.

Why is adult stem cell research exciting?

Bone marrow and skin grafts are technologies that have been used since the 1960s and have recently been re-badged as stem cell therapy. They are not controversial techniques. During the past few years researchers have been testing whether adult stem cells can do more novel types of repair. Can bone marrow stem cells help to heal damaged heart tissue (after a heart attack) or spinal cord (after an accident)? Can stem cells from cord blood, or from the lining of the back of the nose, repair an injured spinal cord? Although this is an important area of stem cell research, whether or not it will lead to treatments remains unproven.

What are embryonic stem cells?

These stem cells are derived from fertilised embryos that are less than a week old. They have not differentiated, which means they are not yet committed to a specific function. However, they have the ability to develop into almost any cell type found in the body and are important for producing normal cells to potentially repair or replace diseased or damaged tissues.

These embryos are donated by couples undergoing IVF. Many couples prefer to see a surplus embryo used for research rather than thrown away. They have to give informed consent and researchers who wish to use them must pass a rigorous government test in order to obtain a licence.

Why is research into human embryonic stem cells so controversial?

The major objection arises from the fact that these stem cells are derived from an embryo, which is destroyed in the process. This is disturbing for those who believe that an embryo is a human being from the moment of conception. Others point out that these are no longer required for infertility treatment and would be destroyed anyway.

What is the potential of embryonic stem cell research?

No one really knows. Embryonic stem (ES) cells were first isolated in humans only recently (1998) and the research is still in its infancy. Of the many different sources of stem cells, only those from embryos have the potential to become almost any of the body's cell types. They are also able to proliferate limitlessly in the culture dish and these properties have led researchers in the field to claim that the technologies that may develop could have significant medical potential.

The ability of ES cells to replicate without limit is particularly important, since meeting the global demand for replacement tissues would require the production of vast amounts of cells. However, the use of ES cells as a source of transplant tissue, unlike adult and cord blood stem cells, raises concerns because ES cells in mice can cause tumours when transplanted. This issue must be addressed before these cells can be used safely in clinical therapy.

What is therapeutic cloning?

Therapeutic cloning is also called somatic cell nuclear transfer (SCNT). The technique involves taking the nucleus (which contains genetic material) from the skin cell of a patient and inserting it into an egg whose nucleus has been removed. With the right triggers, this new cell will develop into an embryo. Scientists can extract stem cells from it, and use those cells to grow tissue. This might allow stem cells to be made from a patient that could be re-introduced into the patient's body without rejection by the person's immune system. It could also enable scientists to understand more thoroughly the triggers and process of that disease.

What is reproductive cloning?

It is also sometimes referred to as human cloning. At the moment, no one has shown any evidence that it is possible. However, if the embryo produced through SCNT were to be implanted into a woman's uterus, there is a tiny chance it would develop into a baby, as happened for Dolly the sheep. Not only would this be illegal in Australia, but according to most doctors and scientists it would be unethical. Animal experiments show the vast majority of clones abort and many of those born are abnormal.

Why is therapeutic cloning controversial?

Some people object to the process because they say it creates life by the artificial means of cloning. The fact that these embryos are then destroyed may compound the distress, because it is again in this view, the destruction of a human being.

There is also a fear that mastering this technology will pave the way for reproductive cloning. That is a valid concern, even though the embryos created by SCNT are not the equivalent of embryos created by the fusion of sperm and egg and have a very limited capacity for normal development. However, many believe this could be dealt with by robust legislation.

Another worry is that because therapeutic cloning may require the use of large numbers of human eggs, women might be coerced to donate eggs or exploited through financial enticement. Both concerns have been shown to have some basis in reality in the fraudulent experiments reported from South Korea. Again, robust legislation could address these concerns.

In the future it may be possible to avoid using human eggs for therapeutic cloning. If stem cells rather than eggs are used to reprogram genetic material, or if animal eggs are used, some of the ethical issues are avoided.

Therapeutic cloning in Australia

In 2002, legislation was passed that banned all forms of human cloning as well as SCNT, but required the Government to review the issue after three years. In 2005 the Lockhart committee (composed of experts from law, ethics, medicine and science) was appointed by the Government to examine whether the law should be revised. It carried out extensive public consultation and its report recommended unanimously that the ban on reproductive cloning should be upheld, but that SCNT and other research which could produce therapeutic gains should be permitted, subject to careful regulation.

In June 2006 the Federal Cabinet decided that the Government did not wish to change the law to allow research into cloned embryos but did allow a parliamentary debate on the issue. In December 2006 however, the ban was overturned by a landmark vote in the Australian Parliament. The legislation will now be consistent with other countries that allow SCNT such as Belgium, India, Israel, Singapore, South Korea, the UK as well as the US in specific states.

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