

Stem Cell Research

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Abstract

This report will discuss the state of stem cell research, and further innovations that are happening in this area.

Introduction

Stem cells are primal cells found in all multi-cellular organisms. They retain the ability to renew themselves through mitotic cell division and can differentiate into a diverse range of specialized cell types. Research in the human stem cell field grew out of findings by Canadian scientists Ernest A. McCulloch and James E. Till in the 1960s.[1][2] Since then many advances have taken place in stem cell research, particularly using stem cells to rejuvenate or regrow entire organs. These shall also be discussed.

What are stem cells?

The three broad categories of mammalian stem cells are: **embryonic stem cells**, derived from blastocysts, **adult stem cells**, which are found in adult tissues, and **cord blood stem cells**, which are found in the umbilical cord. In a developing embryo, stem cells can differentiate into all of the specialized embryonic tissues. In adult organisms, stem cells and progenitor cells act as a repair system for the body, replenishing specialized cells.

Stem cells have the remarkable potential to develop into many different cell types. Serving as a sort of repair system for the body, they can theoretically divide without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell.

Embryonic stem cell

Embryonic stem cell lines (ES cell lines) are cultures of cells derived from the epiblast tissue of the inner cell mass (ICM) of a blastocyst or earlier morula stage embryos. A blastocyst is an early stage embryo - approximately 4 to 5 days old in humans and consisting of 50–150 cells. ES cells are pluripotent (meaning they can grow into a variety of cells).

Most current research has taken place using mouse or human embryonic stem cells. We have to take care to maintain optimal culture conditions, or genetically manipulate them; otherwise they differentiate quickly.

There's controversy surrounding embryonic stem cell research. Many people believe that taking an embryo and using it for scientific purposes is antireligious and ethically unsound. Quite a few countries have a cap on ES research or forbid it.

Adult stem cells

The term Adult stem cell refers to any cell which is found in a developed organism that has two properties: the ability to divide and create another cell like itself and also divide and create a cell more differentiated than

itself. Also known as **somatic** stem cells, they can be found in children, as well as adults. Adult stem cells are not pluripotent. They are restricted in terms of the types of cell types it can differentiate into.

A great deal of adult stem cell research has focused on clarifying their capacity to divide or self-renew indefinitely and their differentiation potential. In mice, pluripotent stem cells can be directly generated from adult fibroblast cultures. Adult stem cell treatments have been used for years to treat leukemia and bone/blood cancers through bone marrow transplants.

Division

So that the number of stem cells remain constant in a population, stem cells undergo two types of cell division—symmetric and asymmetric. Symmetric division produces two identical daughter stem cells, while asymmetric division produces only one stem cell and a *progenitor* cell with limited self-renewal potential. Progenitors can divide many times before differentiating finally into a mature cell.

Significant research has focused on the signals that ‘reprogram’ a cell to become embryonic. Initial studies indicate that transformation of mice cells with a combination of these anti-differentiation signals can reverse differentiation and may allow adult cells to become pluripotent.

Treatments

Researchers believe that stem cell therapy can radically change the treatment of human disease. Bone marrow transplants are already used to treat leukemia [3]. In future, it is anticipated that technologies from stem cell research can be used to treat cancer, parkinson’s disease and muscle damage.

Conclusion

Stem cell research is an exciting frontier which could make a lot of treatments possible. There is controversy surrounding stem cell research, however in 2005, researchers at Kingston University in England discovered a type of stem cell in umbilical cords, which can differentiate into more types of tissues than adult stem cells. Adult stem cells are already used to treat leukemia using bone marrow transplants. Current research shows that stem cells are more versatile important for research to continue unhindered but ethical controls should be there, so that no exploitation semi-formed human embryos happen.

References

Primary sources

- Wikipedia article on stem cells, http://en.wikipedia.org/wiki/Stem_cell
- <http://stemcells.nih.gov>

Secondary sources

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