What are Stem Cells?

Learn about the different types of stem cells, what they do and why they are important.

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Stem cells are cells of the body that have the ability to differentiate into other cell/tissue types. These unspecialized or un-programmed cells have the potential to change into muscle, cartilage, bone or other specialized cell types. Any body part that regenerates or "repairs itself" has stem cells. Stem cells act as backup, ready to replace other cells that get damaged. There is no current evidence that back-up stem cells exist for vital tissues and organs such as: nerves, spinal cord, brain, heart, kidneys and pancreas. The development of new sources of stem cells for these tissues is currently in the research phase.

Types of stem cells

Within the new field of science called regenerative medicine, there are four types of stem cells used for treatments, research and development:

- **embryonic stem cells**
- **fetal stem cells**
- **cord blood stem cells**
- **adult stem cells**

Embryonic stem cells:
Embryonic stem cells are extracted from a human egg that has been fertilized by a sperm. These stem cells are pluripotent; this means that they can transform into **any cell type found in the body** with no restrictions or limitations. Embryonic stem cells can easily be matured into any functional adult cells such as muscle, organ, nerve, and brain. Embryonic stem cells have the potential to treat diseases such as Parkinson's, Alzheimer's, Diabetes, Cancer and more.

There are two main problems with using embryonic stem cells for treatment purposes:

1. There is an ethical and moral debate regarding the use of a fertilized human egg for treatment and research purposes.
2. There is a potential for tissue rejection (similar to the rejection in a heart, liver or blood transplant). This can limit the curative usefulness of embryonic stem cells.

Due to these issues many stem cell research organizations are working on developing stem cells from unfertilized eggs.

Fetal stem cells:
Fetal stem cells are stem cells extracted from the developing tissues and organs of an aborted fetus. A fetus contains a relatively large supply of stem cells which are needed for growth and maturation. Fetal stem cells are believed to be more versatile than adult stem cells and less versatile than embryonic stem cells. The stem cells in a fetus are semi-mature stem cells.

Similar to embryonic stem cells, there are a few issues with using fetal stem cells for treatment purposes:

1. There is an ethical and moral debate regarding the use of fetal tissue for treatment and research purposes.
2. The number of stem cells in the fetal tissues may not be sufficient for the medical treatment of adults
3. There is a risk of tissue rejection (similar to the rejection in a heart, liver or blood transplant).

Cord blood stem cells:
Cord blood stem cells are extracted from the umbilical cord, they are the earliest cells found in the fetus. Cord blood stem cells are hematopoietic; this means that they can only transform into different types of blood cells. Similar to bone marrow stem cells, cord blood stem cells can be used to treat a number of blood related diseases and cancers.

In using a patient's own stem cells the risk of rejection is minimal and the process is non-invasive as opposed to the extraction of bone marrow. The full extent of the therapeutic benefits from cord blood stem cells has not yet been realized.

Adult stem cells:
Adult stem cells are the back-up supply of cells extracted from adult tissue and organs that "auto-repair" when damaged. For example there are reparative cells in the skin and liver from which skin stem cells and liver stem cells can be extracted. Adult stem cells are multipotent, meaning that they are semi-programmed. For example, a skin stem cell cannot be transformed into a heart muscle cell. Adult skin stem cells can only become cells of the skin.

Stem cell progress

In Barcelona on June 2008, doctors implanted a newly constructed windpipe into a 30 year old patient. The windpipe was partially constructed with tissue grown from the patient's own adult stem cells. This is one of the first transplants in which the doctors created a functional, biological structure that can't be rejected. This advancement eliminates the need for anti-rejection drugs, which can often be accompanied by side effects such as high blood pressure, cancer and kidney failure. Details of the Clinical transplantation of a tissue-engineered airway can be found online in The Lancet medical journal.

Recently, there have been discoveries suggesting that cord blood stem cells and other adult stem cells, under the right circumstances, may be conditioned to transform into organ cells. On Feb. 11, 2008, in an early online edition of the research journal Proceedings of the National Academy of the Sciences, UCLA researchers published their progress regarding genetic alteration of human skin cells to create cells that are nearly identical to human embryonic stem cells.

Cord blood stem cells have been used to treat a variety of different diseases. A list of common treatments is available at www.mazecordblood.com/cordblood-transplant.htm. In addition, a number of researchers are working on a variety of exciting treatments using cord blood. These include treatments for diabetes and cerebral palsy.

These examples of stem cell treatment illustrate the healing potential of stem cell research.

About the Author

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