Types of Stem Cells

Many different terms are used to describe various types of stem cells, often based on where in the body or what stage in development they come from. You may have heard the following terms:

1. Adult Stem Cells or Tissue-specific Stem Cells

Many adult tissues contain stem cells that can replace cells that die or restore tissue after injury. Skin, muscle, intestine and bone marrow, for example, each contain their own stem cells. In the bone marrow, billions of new blood cells are made every day from blood-forming stem cells.

Adult stem cells are tissue-specific, meaning they are found in a given tissue in our bodies and generate the mature cell types within that particular tissue or organ. It is not clear whether all organs, such as the heart, contain stem cells. The term 'adult stem cells' is often used very broadly and may include fetal and cord blood stem cells.

There are a few stem cell therapies that are widely accepted by the medical community and these use tissue-specific stem cells. These are bone marrow or cord blood stem cell transplantation to treat diseases and conditions of the blood or to restore the blood system after treatment for specific cancers, skin stem cell therapies for burns and limbal stem cells for corneal replacement. In each case, the stem cells repair the same tissue from which they came.

Another type of adult stem cell is the mesenchymal stem cell. These are found in a number of tissues, including bone marrow, and may be able to produce bone, cartilage and fat. It is also possible that these or similar cells may aid in the regeneration of tissues. Extensive animal studies are currently ongoing to determine if these cells may be used for treatment of diseases such as arthritis and non-healing bone fractures. It is also possible that these or similar cells modulate the immune system in response to injury.

2. Fetal Stem Cells

As their name suggests, fetal stem cells are taken from the fetus. The developing baby is referred to as a fetus from approximately 10 weeks of gestation. Most tissues in a fetus contain stem cells that drive the rapid growth and development of the organs. Like adult stem cells, fetal stem cells are generally tissue-specific, and generate the mature cell types within the particular tissue or organ in which they are found.

3. Cord Blood Stem Cells

At birth the blood in the umbilical cord is rich in blood-forming stem cells. The applications of cord blood are similar to those of adult bone marrow and are currently used to treat diseases and conditions of the blood or to restore the blood system after treatment for specific cancers. Like the stem cells in adult bone marrow, cord blood stem cells are tissue-specific.

4. Embryonic Stem Cells

Embryonic stem cells are derived from very early embryos and can in theory give rise to all cell types in the body. However, coaxing these cells to become a particular cell type in the laboratory is not trivial. Furthermore, embryonic stem cells carry the risk of transforming into cancerous tissue after transplantation. To be used in cell transplant treatments the cells will most likely need to be directed into a more mature cell type, both to be therapeutically effective and to minimize risk that cancers develop. While these cells are already helping us better understand diseases and hold enormous promise for future therapies, there are currently no treatments using embryonic stem cells accepted by the medical community.

5. Induced Pluripotent Stem Cells (iPS cells)

In 2006, scientists discovered how to "reprogram" cells with a specialized function (for example, skin cells) in the laboratory, so that they behave like an embryonic stem cell. These cells, called induced pluripotent cells or iPS cells, are created by inducing the specialized cells to express genes that are normally made in embryonic stem cells and that control how the cell functions. Embryonic stem cells and iPS cells share many characteristics, including the ability become the cells of all organs and tissues, but they are not identical and can sometimes behave slightly differently. IPS cells are a powerful method for creating patient- and disease-specific cell lines for research. However, the techniques used to make them need to be carefully refined before they can be used to generate iPS cells suitable for safe and effective therapies.