Stem Cells: How Do They Help Us?

What are Stem Cells?

A **stem cell1** is an amazing type of cell contained in the human body. This cell has the potential to become a number of different cells in the body. They are in many tissues and organs, and they serve as a repair system (National Institute of Health, 2016). These cells are able to divide almost indefinitely as long as the human is still alive. (National Institute of Health, 2016). Although most experiments on stem cells take place outside of the human body. If the conditions are favorable the stem cell can survive and replicate. Stem cells are found in all humans, from the earliest stages of human development to the end of a person’s life. (Kalra & Tomar, 2014). Stem Cells play an important part in the development of an embryo because they are what becomes the **specialized2** cells to create tissues and organs. In the gut and bone marrow, stem cells are able to divide regularly to replace damaged cells (National Institute of Health, 2016). Stem cells in other areas, such as the heart and pancreas, only divide under special conditions (National Institute of Health, 2016).

What Makes Stem Cells So Special?

Stem cells have three unique properties: They are **unspecialized3,** they divide and renew themselves for long periods of time, and they can become specialized cells (National Institute of Health, 2016). Stem cells being unspecialized means they do not have a job to do in the body yet, besides awaiting instruction to become a specialized cell. Stem cells are not like muscle cells, nerve cells or blood cells because those other cells are usually unable to create a new version of themselves. (National Institutes of Health, 2016). A regular cell just creates another copy of itself, while a stem cell creates a brand new specialized cell. **Proliferating4** is an ability stem cells have that allows them to replicate themselves many times. (National Institutes of Health, 2016). When a population of stem cells is grown in a laboratory setting and continues to proliferate for a while (National Institutes of Health, 2016). If they continue to be unspecialized, the cells are capable of long term self-renewal (National Institutes of Health, 2016). A stem cell is considered unspecialized because it is unable to do the work of other cells. However, if the stem cell becomes specialized then it can take on the role of other cells, such as blood, muscle, or nerve cells. This process is called differentiation (National Institutes of Health, 2016). The ability for stem cells to become specialized is through signals and triggers inside and outside of the cell (National Institutes of Health, 2016). The internal signals that can cause differentiation are located in the stem cells genes, and the external signals are controlled by chemicals secreted by other cells throughout the body, as well as contact with other cells (National Institutes of Health, 2016).

Different Types of Stem Cells

There are many different types of stem cells but there are usually two categories: **embryonic5** stem cells and adult stem cells. Embryonic stem cells are of course from an embryo. These stem cells are responsible for creating the cells, tissues and organs of a fetus. Most of the embryonic stem cells are eggs that were fertilized in vitro, or in a laboratory setting, and then donated for research. Previously, to generate human embryonic stem cells, they transfer the embryonic cells from a preimplantation-stage and move them into a plastic dish that contains a culture medium (National Institutes of Health, 2016). The cells are then coated with mouse embryonic skin cells treated so they will not divide (National Institutes of Health, 2016). The embryonic mouse cells give the human embryonic stem cells a place to stick to (National Institutes of Health, 2016). Currently researchers are able to use other methods because the previous methods were risky, with the ability to transmit disease and viruses (National Institutes of Health, 2016). If embryonic stem cells are grown appropriately they stay undifferentiated (National Institutes of Health, 2016). If the embryonic stem cells clump together in a dish they start to differentiate (National Institutes of Health, 2016). If the embryo had continued to grow in a human this differentiating would’ve created the muscle cells, nerve cells and blood cells required to make a fetus. Researchers have tried to control the differentiation of these stem cells in order to create specialized cells by inserting certain genes to trigger differentiation (National Institutes of Health, 2016).

Adult stem cells are a bit different in that they reside around differentiated cells in tissues and organs. These undifferentiated cells are mostly awaiting assignment for a repair in each tissue or organ that they are located in (National Institutes of Health, 2016). These cells are less likely to divide when removed from the body (National Institutes of Health, 2016). A few places these stem cells are located are: brain, bone marrow, blood vessels, skeletal muscle, skin, teeth, heart, gut, liver, ovarian epithelium and testes (National Institutes of Health, 2016). In adults there are stem cells that reside in specific places that eventually have specific jobs. **Hematopoietic6** stem cells are what create the different types of blood cells. **Mesenchymal7** stem cells are present in many tissues, and mostly relate to structural parts of the body (National Institutes of Health, 2016). Neural stem cells are exactly what they sound like, they are responsible for the nerve cells (National Institutes of Health, 2016). **Epithelial8** stem cells line the digestive tract, and skin stem cells reside in the lower levels of the epidermis and at the base of hair follicles (National Institutes of Health, 2016). All of these cells are responsible for repair in their specific location.

How Can Stem Cells Be Used to Help?

Since stem cells have such unique properties there may be a chance that these cells can be manipulated so specific tissues will grow (Kalra & Tomar, 2014). This is where stem cell therapy comes in. Stem cell therapy is a way to replace injured or diseased tissues with stem cells that would grow and create new, healthy tissue (Kalra & Tomar, 2014). When a person has type 1 diabetes, pancreatic cells that produce insulin are eliminated by the person’s immune system however, new studies suggest that stem cells can be differentiated into insulin producing cells and transplanted into a patient with type 1 diabetes (National Institutes of Health, 2016). There are a few challenges to face before stem cells can be used across the board in stem cell therapy. There could be rejection of stem cells in the patient receiving the treatment, the stem cells could not last the patients entire life, or the stem cells could not differentiate correctly (National Institutes of Health, 2016). Stem cells are extremely beneficial in development as well as healing a human body. The possibility of stem cells becoming a way of curing diseases, or repairing damaged tissue is a reachable goal, though it may require more research and a few more years.

Vocabulary

1. Stem Cell: *noun-* an undifferentiated cell of a multicellular organism that is capable of giving rise to indefinitely more cells of the same type.
2. Specialized: *adj-* adapt or set apart (an organ or part) to serve a special function or to suit a way of life.
3. Unspecialized: *adj-*having no specialty, or purpose.
4. Proliferating: *verb-* to grow by rapid production of new parts, cells, buds, or offspring.
5. Embryonic: *adj-* being in an early stage of development.
6. Hematopoietic: *noun*­- the formation of blood or blood cells in the living body.
7. Mesenchymal: *noun-* multipotent stromal cells that can differentiate into a variety of cell types, including osteoblasts (bone cells), chondrocytes (cartilage cells), myocytes (muscle cells), and adipocytes (fat cells).
8. Epithelial: *adj-* relating to or denoting the thin tissue forming the outer layer of a body’s surface and lining the alimentary canal and other hollow structures.

References

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