Stem Cells Will Soon Provide Cures for Many Diseases


"Most scientists find stem cell therapy so promising that they believe it is only a matter of time before its use becomes routine."

In the following viewpoint, the Stem Cell Research Foundation presents an optimistic outlook toward stem cell therapy that suggests that in the very near future such research will be used to provide dramatic cures for devastating illnesses. The foundation describes how embryonic stem cells cultured in the lab can be transplanted into people in a process similar to organ transplantation. The transplanted stem cells can replace damaged cells in diabetics, people with spinal cord injuries, and people who suffer from many other diseases. Despite challenges, the group asserts that stem cell therapy will soon become commonplace. The Stem Cell Research Foundation is a nonprofit organization that supports and promotes stem cell therapy research.

As you read, consider the following questions:

1. What is the definition of "stem cell therapy," according to the author?
2. What are "terminally differentiated cells"?
3. Name two challenges that must be overcome before stem cell therapy becomes commonplace.

Medicine today is moving rapidly toward the development of more effective cures for a host of diseases. In the past, doctors could usually only treat the symptoms of illness—treatments rarely addressed the causes. Today, many of the cures being developed by scientists are based on advanced techniques that target the root cause of disease rather than simply treating the symptoms. One of those techniques is called stem cell therapy.

What Is Stem Cell Therapy?

Stem cell therapy can be defined as a group of new techniques, or technologies, that rely on replacing diseased or dysfunctional cells with healthy, functioning ones. These new techniques are being applied experimentally to a wide range of human disorders, including many types of cancer, neurological diseases such as Parkinson's disease and ALS (Lou Gehrig's Disease), spinal cord injuries, heart disease and diabetes. Even blinding diseases of the retina may someday be cured by replacing dead retinal cells with new ones. To understand how stem cell therapy works, it helps to understand the role of cells in the body.

The Function of Cells

Cells are the basic building blocks of the human body. These tiny structures compose the skin, muscles, bones and all of the internal organs. They also hold many of the keys to how our bodies function. Cells serve both a structural and a functional role, performing an almost endless variety of actions to sustain the body's tissues and organs. The healthy functioning of all our cells is crucial to the maintenance of health. There are hundreds of different specialized cell types in the adult body. All of these cells perform very specific functions for
the tissue or organ they compose. For example, specialized cells in the heart muscle "beat" rhythmically through the conduction of electrical and chemical signals, while the cells of the pancreas produce insulin to help the body convert food to energy. These mature cells have been differentiated, or dedicated, to performing their special tasks. Conventional wisdom has long maintained that under normal conditions, once a cell has become specialized, it cannot be changed into a different type of cell.

Like the body itself, cells have a finite life span; they eventually die. Most of the body's cells divide and duplicate throughout life, but some cells either don't replenish themselves or do so in such small numbers that they cannot replace themselves fast enough to combat disease. This is true for the cells of the brain and the heart, for example. In diseases like heart disease and Parkinson's, the death of cells overtakes the body's ability to replace them, and this eventually results in the failure of the organ.

**How Does Stem Cell Therapy Work?**

While cells are indispensable in performing vital functions for the body, they can also exist outside the body. They can live and divide in "cultures," or special solutions in test tubes or petri dishes. This ability of certain cell types to live isolated from other cells under controlled conditions has allowed scientists to study them independently of the organ or system they are normally a part of. Through the isolation and manipulation of cells, scientists are finding ways to identify young, regenerating ones that can be used to replace damaged or dead cells in diseased organs. This therapy is similar to the process of organ transplant, only the treatment consists of the transplantation of cells rather than organs. The cells that have shown by far the most promise of supplying diseased organs with healthy new cells are called stem cells.

**Stem Cells Are Highly Versatile Cells**

Simply put, stem cells are "primitive" cells, made early in an organism's development, that give rise to other types of cells. Also called progenitor cells, there are several kinds of stem cells. Totipotent cells are considered the "master" cells of the body because they contain all the genetic information needed to create all the cells of the body plus the placenta, which sustains the human embryo. Human cells have this capacity only during the first few divisions of a fertilized egg. After 3-4 divisions of totipotent cells, there follows a series of stages in which the cells become increasingly specialized.

The next stage of development produces pluripotent cells, which are highly versatile and can give rise to any cell type except the cells of the placenta. At the next stage, cells become multipotent, meaning they can give rise to several other cell types, but those types are limited in number. An example of multipotent cells is hematopoietic cells—blood stem cells that can develop into several types of blood cells, but cannot develop into brain cells. At the end of the long chain of cell divisions that make up the embryo are "terminally differentiated" cells—cells that are considered to be permanently committed to a specific function.

Scientists have long held the opinion that differentiated cells cannot be altered or caused to behave in any way other than the way in which they have been naturally committed. New research, however, has called that assumption into question. In recent experiments, scientists have been able to persuade blood stem cells to behave like neurons, or brain cells. Scientists
now believe that stem cell research could reveal far more vital information about our bodies than was previously known.

In addition, it was recently discovered that some stem cells also occur in the bodies of adults, rather than exclusively in embryos. Many kinds of multipotent stem cells have been discovered in adults, and scientists believe that many more will be discovered. Research is now being conducted on both adult and embryonic stem cells to determine the characteristics and potential of both to cure disease.

**Stem Cell Therapy Is Building Toward Its Potential**

Even though most of the work done in this field has been experimental, most scientists find stem cell therapy so promising that they believe it is only a matter of time before its use becomes routine. And while many of the hoped-for uses of cell therapy sound futuristic, there are a few forms of this technique that have already been in use for years. Bone marrow transplants are an example of cell therapy in which the stem cells in a donor's marrow are used to replace the blood cells of the victims of leukemia and other cancers. Cell therapy is also being used in experiments to graft new skin cells to treat serious burn victims, and to grow new corneas for the sight-impaired. In all of these uses, the goal is for the healthy cells to become integrated into the body and begin to function like the patient's own cells.

So far, the results of such experiments have exceeded expectations. In a recent advance, pancreatic cells were implanted into the body of a diabetic and began to produce insulin. Even though cell therapy is a new science, early results like these have caused great optimism in the scientific community. However, there are several scientific challenges that must be overcome before we can truly harness the power of stem cells.

**What Are Some of the Challenges?**

One of the first challenges that must be overcome for stem cell therapies to become more commonplace is the difficulty of identifying stem cells in tissue cultures, which contain numerous types of cells. While scientists are discovering new cell types almost every day, they estimate that there could literally be hundreds of human cell types. The process of identifying any desired type of stem cell will involve painstaking research. Second, once stem cells are identified and isolated, the right biochemical solution must be developed to cause these progenitor cells to differentiate into the desired cell types. This too will require a great deal of experimentation.

Assuming that the above obstacles have been overcome, new issues arise when the cells are implanted into a person. The cells must be integrated into the patient's own tissues and organs and "learn" to function in concert with the body's natural cells. Cardiac cells that beat in a cell culture, for example, may not beat in rhythm with a patient's own heart cells. And neurons injected into a damaged brain must become "wired into" the brain's intricate network of cells and their connections in order to function properly.

Yet another challenge is the phenomenon of tissue rejection. Just as in organ transplants, the body's immune cells will recognize transplanted cells as "foreign," setting off an immune reaction that could cause the transplant to fail and possibly endanger the patient.
recipients would have to take drugs to suppress their immune systems, which in itself could be dangerous.

Yet another concern is the possible risk of cancer. Cancer results when cells lose their internal "brakes" and keep dividing when further proliferation is no longer desirable. Researchers must find a delicate balance between fostering the growth of new cells to replenish damaged tissues and making sure that cells don't overgrow and become cancerous. However, most scientists believe that, with the appropriate research, these obstacles can be overcome and the power of stem cells can be harnessed.

**Stem Cells Have the Potential to Revolutionize Medicine**

Despite the many challenges before us, many scientists believe that stem cell therapy will revolutionize medicine. With the use of stem cell therapies, we may soon have dramatic cures for cancer, heart failure, Parkinson's disease, muscular dystrophy, diabetes, kidney disease, multiple sclerosis and a host of other diseases. Stem cell therapies have also shown great promise in helping to repair catastrophic spinal injuries, helping victims of paralysis regain movement, and repairing severe brain injury following a stroke. It is even possible that the human life span could be greatly extended due to the replenishment of tissues in aging organs. We may even have the ability one day to grow out our own organs for transplantation from our own stem cells, eliminating the danger of rejection. While we will undoubtedly encounter the limits of cell therapy one day, there is every reason to hope that this revolutionary new approach will result in radically improved ways to treat disease.

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