Research Using Stem Cells

A core element of the Alzheimer’s Association’s mission is to eliminate Alzheimer’s disease through the advancement of research. To this end, the Association is committed to discovering the causes of Alzheimer’s, prevention strategies, methods for better and earlier diagnosis, more effective treatments and ultimately a cure for this fatal disease.

The Alzheimer’s Association supports and encourages any legitimate scientific avenue that offers the potential to advance the goal of eliminating Alzheimer’s, including stem cell research. We oppose any restriction or limitation on research, provided that appropriate scientific review and ethical and oversight guidelines and compliance are in place.

As the body develops, most cells become very specialized—or differentiated—and many lose the ability to replenish themselves through cell division. A stem cell, simply put, is a cell that retains the ability to divide and is relatively undifferentiated, meaning that it can still give rise to another type of cell (such as a neuron or a red blood cell).

There are different types of stem cells. Some of the principal types are listed below.

- Embryonic stem cells are derived from embryonic tissue. The majority of human embryonic stem cells are derived from embryos that come from eggs that have been fertilized in vitro (not from embryos fertilized in a woman’s body). Embryonic stem cells (either animal or human) can divide many times, giving rise to millions of stem cells from just a single starting cell. In addition, embryonic stem cells can be directed to differentiate into a wide variety of specialized cells. For some medical conditions, these specialized cells may be able to be used to replace cells or cellular factors (such as proteins) that are lost or damaged as a result of disease or that may be therapeutic. In other cases, researchers may be able to use the specialized cells to learn more about the disease process, opening new possibilities for prevention or treatment.

- Adult stem cells are stem cells that live among the differentiated cells of adult tissues or organs. Adult stem cells are usually able to differentiate into one or more of the specialized cells of the tissue or organ in which they reside, but not into other cell types. That is, their capacity for differentiation is limited. Not all tissues and organs have adult stem cells. In addition, numerous specialized cell types are only produced during early development and last a lifetime. Many neurons fall in this category.
• Induced pluripotent stem cells (iPSCs) are adult cells that have been reprogrammed to become more like embryonic stem cells by directing them to express developmental genes. While this causes the adult cells to “de-differentiate” and allows them to give rise to other types of cells, it is not known whether embryonic stem cells and induced pluripotent stem cells differ in clinically significant ways.

• The advent of stem cell technology suggests that we may ultimately be able to use stem cells to develop a cure for Alzheimer’s disease—and it provides several pathways for this critical research:

• Therapy development: Scientists envision that treatments that are currently being developed to reduce the brain cell death in Alzheimer’s—thus creating a healthier environment within the brain—may be used in conjunction with future stem cell-based therapies to not only stop the disease but also possibly restore once-lost functioning.

• Research into the causes of Alzheimer’s: Despite the creation of valuable animal models of Alzheimer’s from which we have learned a great deal, it is only humans that fully develop the classic features of Alzheimer’s disease. The ability of human embryonic stem cells or iPSCs to form any type of human cell makes them attractive candidates for scientists to use to create alternative and complementary models of the healthy or diseased human brain for testing ideas, theories, therapies, etc.

• It is now possible to create stem cell lines from the skin cells of individual Alzheimer’s patients and induce them to become neurons or other brain cells. Through examining these cells we may be able to identify patient-specific processes that cause or contribute to the development of Alzheimer’s and identify genes that can delay or prevent the disease. This may also enable us to create entirely new, targeted therapies.

• New drugs can be tested for safety and effectiveness on stem cells or on specialized cells derived from stem cells. As described above, scientists can now use stem cells to create neurons and other brain cells, and these cells are being used to determine whether potential new medications can alter the disease processes that are associated with Alzheimer’s. Other cell lines, such as cancer cells, have a long history of being used to screen new medications in this way.
Alzheimer’s poses unique challenges because it affects many types of brain cells in multiple brain regions. At this time, it is unclear if stem cells can form all these different cell types. We also don’t yet know if the brain cells created from stem cells, or other cellular factors (such as proteins) derived from them, could effectively and safely repair the extensive network of cell-to-cell connections that are damaged when brain cells die in Alzheimer’s.

The discoveries to date, point to the intense need for more and continued Alzheimer’s research in every area to drive us closer to the Association’s goal of a world without Alzheimer’s disease.

— Alzheimer’s Association Medical and Scientific Advisory Council, reviewed September 2015