Can Stem Cells Really Treat Parkinson's Disease?

By Rana Ghobashy

We hear a lot about stem cells being the miracle cure for so many uncured terminal diseases—but what are stem cells and how can they be the solution for so many different diseases? I'll start by defining stem cells—stem cells are "unspecialized" cells, meaning that they do not have a specific function the way that fully specialized cells of your organs and tissues do, like liver cells producing bile or red blood cells transporting oxygen. However, what makes stem cells great is that they can morph into almost any kind of specialized cell when given the right environment. In other words, stem cells start off being ambiguous but become more specific with a given set of instructive proteins from their surroundings. Stem cells can also proliferate (divide) indefinitely—this is great for scientists working with them, because it means they can have a large population of cells to use for patients. So, if a disease is caused by the loss of a particular cell type or damaged cells, the idea behind stem cell therapy is that scientists could use stem cells to create the healthy cell type a patient is in need of and introduce the new healthy cells to the patient.

One uncured disease that is turning to stem cell therapy for hope is Parkinson's disease. Parkinson's disease is a brain disorder that is caused when brain cells, also known as neurons, in the basal ganglia (a structure in the brain) become compromised and degenerate. In the case of Parkinson's, the neurons that degenerate are usually responsible for producing a brain chemical called dopamine (these neurons are referred to as dopaminergic neurons). Because dopaminergic neurons in the basal ganglia help facilitate body movement, symptoms of Parkinson's disease include shaking, stiffness of muscles, tremors, and poor balance. The goal of using stem cell

therapy to treat Parkinson's disease is to restore functional dopaminergic neurons in the brain to stop the disease from progressing any further.

One major concern that many people have with stem cell therapies is the possibility of patients rejecting the introduced cells. In the same way that patients who need organ transplants are at risk of rejecting the donated organ due to it being something foreign in their body, this concept also applies to stem cells. Administering stem cells from a donor poses a risk of rejection because the cells are not genetically identical to the donor. The good news is that there is a type of stem cell technology that eliminates this risk—these amazing cells are called iPSCs: induced pluripotent stem cells. The "induced" part of the name refers to the fact that iPSCs are actually derived from cells that once had a specialized function (usually from skin cells). The specialized cells are reprogrammed into being unspecialized—in other words, specialized cells are transformed into stem cells! This is done by introducing a combination of specific proteins into the cellular environment. An analogy to consider: imagine you see a mom telling her child to do their chores; once the child receives the instructions, the child completes the chores. In this potentially over-idyllic scenario, the mom is the protein (provides specific instructions), and the child is the cell (they changed function according to instructions). In this same way, we can take a skin cell and turn it into a stem cell with specific proteins that provide the necessary instructions to the cell. The most important detail is that iPSCs can be created using cells from the patient! Once the iPSCs are created from the patient, the scientists will have a stem cell population that is genetically identical to the patient. These iPSCs can then be turned into any specialized cell type that the patient needs.

So, stem cells can turn into any specialized cell type and we can eliminate the possibility of rejection by obtaining specialized cells from the patient, reprogramming those cells into iPSCs, turning the iPSCs into the cell type needed by the patient, and administering them back into the patient. Better known as "autologous transplantation," scientists harvest the patient's own cells then introduce them back into their bodies once modified into the desired cells type. In the case of Parkinson's disease, we could take skin cells, transform them into iPSCs, then instruct the iPSCs to develop into dopaminergic neurons, which could then be introduced to the patient's brain without fear of rejection. There have not been enough clinical studies done to definitively prove that stem cells will be a long-term solution to Parkinson's disease. However, studies thus far show very promising results with increased motor movements in patients with administered iPSC-derived neurons.

Parkinson's disease is a debilitating disease that leaves many hopeless and discouraged. The hope for stem cell therapy is that stem cells can replace or repair damaged cells and/or tissue (in this case, dopaminergic neurons). Scientists and doctors are turning to stem cells to try to fix the root of the problem rather than just treating the symptoms after the disease has already drastically affected the patient's life. Unfortunately, there is currently no definitive treatment for Parkinson's disease other than trying to alleviate the effect of its symptoms on patients, but stem cells and regenerative medicine are providing hope that this will soon change.

References

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