The Challenges and Benefits of Using Stem Cells in Psychiatry

By Jessica Palka

Ongoing research involving stem cell-based interventions for mental illness may have the potential to provide improved treatments or even cures for depression, schizophrenia, and bipolar disorder. In their quest to understand what is going wrong in the brain cells of affected patients, researchers are examining the molecular causes of these disorders to determine if stem cell-based treatments may be used to replenish degenerated brain tissue in patients. The excitement in the field is palpable given the deficit of effective treatments for those suffering with severe mental illness.

The development of treatments for psychiatric diseases has been hampered by difficulties in understanding their underlying causes, which seem to vary wildly. For example, it is not clear whether some mental illnesses begin during embryonic development or develop much later in life. There is significant data suggesting that many mental illnesses are caused by developmental abnormalities of the brain before birth, but other studies indicate that some mental illnesses may be caused by the destruction of adult brain tissues (Benninghoff, 2009). Of course, these scenarios are not mutually exclusive; mental illness can have developmental origins and also involve brain degeneration later in life. Determining when these conditions develop will potentially help scientists and clinicians detect and prevent these illnesses. Many scientists are hopeful that stem cells might be used to reverse the events that lead to the disease. If an illness is caused by or leads to degeneration and loss of brain cells, could stem cells be used to produce new cells in the brain?

Interestingly, it may be that not only can nervous tissue degeneration lead to psychiatric conditions, the latter can also cause the former. A study of individuals suffering from major depression provides evidence that depressive episodes can trigger degeneration of tissues in the adult nervous system (Stratmann et al., 2014). The Individuals examined in the study suffered from a loss of total cell volume in certain brain areas (Benninghoff, 2009). If this result is found to be consistent in future studies, it could mean major depression would be considered a neurodegenerative condition. In this context, stem cells might be used to heal the brain damage inflicted by this mental illness.

Scientists examining psychiatric disorders might benefit from learning about the challenges faced when treating more classical neurodegenerative diseases. In cases with stem-cell based interventions for neurodegenerative diseases like Duchenne's disease, Parkinson's disease, and Alzheimer's disease, there are ongoing discussions about which stem cell type (embryonic, fetal, or adult) is more appropriate for production of neural progenitor cells (Benninghoff, 2009). The progenitor cell is a kind of intermediate or "teenage phase" that differntiating stem cells go through as they develop into adult cell types. By using neural progenitor cells in their research,

scientists can be sure the cells will ultimately develop into neurons rather than skin, muscle, or any other kind of cells.

Trafficking stem cells or progenitor cells to the appropriate location (a process known as stem cell homing) presents another challenge (Benninghoff, 2009). Surgical transplantation of stem cells to a specific area is effective but invasive. Instead, it may be possible to inject stem cells and allow the cells to travel within the circulatory system to the brain where they would home to the appropriate region based on complex molecular and cellular interactions (Benninghoff, 2009). This would allow injection of cells into most any vein, such as the easily accessible median cubital vein in the forearm (from which blood is commonly drawn) (Benninghoff, 2009).

Apart from the technical issues, ethical problems also are ever present when it comes to stem cell research. Controversy will likely always surround the use of human embryonic stem cells. However, this debate has become less relevant thanks to the advent of a process in 2006 that allows scientists to create cells that behave like embryonic stem cells from any adult cell type (for example, a skin cell could be turned into an embryonic stem cell-like cell) (Takahasi & Yamanaka, 2006). These cells, called induced pluripotent stem cells, are reducing the necessity of using human embryonic stem cells in medical research and opening up exciting new options in terms of using stem cells for therapeutic purposes.

Stem cells could offer a much-needed alternative to the pharmacological treatment of mental disorders. Using prescribed medications for mental disorders is problematic since it necessitates patient compliance to a strict schedule of medications (Benninghoff, 2009). This is further complicated by the unfortunate reality that many medications cause undesirable side effects, including changes in appetite, fatigue, nausea, heart problems, general malaise, and sometimes even an increased risk of suicide. Stem cell-based treatments for mental illness may help provide a better alternative to drug compounds for those suffering with mental illness.

As more research is being done in the stem cell field, there is an ever-increasing likelihood that stem cells will be used in the treatment of psychiatric illnesses. Although there are many challenges yet to overcome, the potential benefits of using stem cells to restore proper brain functionality for the millions of people suffering from mental illness offers an incentive that is impossible for the scientific community to ignore.

References

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