Different Types of Stem Cells and Their Applications

One of the most promising advances in science has been the use of stem cells in research and the treatment of disease. In general, stem cells are cells that can be programmed to differentiate into many different types of cells. They also have the ability to "renew" or make copies of themselves.

There are several different types of stem cells including:
a) embryonic stem cells (ESCs)
b) human induced pluripotent stem cells (hiPSCs)
c) adult stem cells (ASCs)

Embryonic stem cells are derived from a fertilized embryo's inner cell mass that can generate all the specialized tissue in the body. These cells are pluripotent meaning they can become almost any cell type; however, they are only found during the early stages of development. Adult stem cells or somatic stem cells are undifferentiated, multipotent cells that will develop into tissue-specific cells in which they are found. Types of ASCs include hematopoietic stem cells, mesenchymal stem cells, neural stem cells, epithelial stem cells, and skin stem cells. Lastly, human induced pluripotent stem cells are originally ASCs that have been "reprogrammed" to behave like ESCs. They were developed in a laboratory and have characteristics of both ESCs and ASCs.

Stem Cells' use and their Challenges:

Stem cells can be used for potential therapy of many different diseases. Currently, all three types of stem cells are being used in therapies. These therapies treat blood disorders such as leukemia and lymphoma, diabetes, spinal cord injury, and heart disease. Although they offer promising treatment, there are several major challenges in using them.

First, ASCs reside deep within a given tissue and are not very abundant. This makes them difficult to identify, obtain, and then culture for use. ESCs are usually the unused embryos created by in vitro fertilization. Although they can be cultured in the lab, this is a difficult and complex process. There are also ethical and moral issues regarding use of ESCs. iPSCs have similar problems as the ESCs. In addition to the complex process of culturing these cells, specific genes need to be "reprogrammed" in iPSCs to allow them to differentiate into the specified cell type. Further investigation needs to be done in order to fully understand these steps.

The second major issue regarding stem cells is the possibility of a recipient rejecting a donor's stem cells, which is similar to the issue with organ transplants. Donor cells need to be closely matched to the recipient's cells in order to avoid rejection. One solution to this problem is the use the iPSCs. This allows the use of patient-specific pluripotent stem cells to be developed into the needed cell type without the risk of rejection and continued immunosuppression.

A final issue is the coordination between the newly implanted stem cells with the body's other cells. These cells need to be able to work together with the established cells in order to achieve success. Implanted new stem cells have to be able to integrate and perform accordingly with the body's already functioning cells and systems.

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Research Solutions and Applications:

The problems associated with stem cell use are complex and need to be investigated further; however, LifeNet Health LifeSciences has several advantages that can help solve these problems. Because we are an organ procurement organization, there is a steady supply of tissue from human neonatal and adult skin (dermal) fibroblasts. These cells can be isolated and used for iPSC studies. In addition, we have in development a human based extracellular matrix (ECM), **Hu**Gentra™, derived from human placentas. iPSCs require specialized ECMs and growth factors for successful differentiation and culture1-3. HuGentra, unlike Matrigel, is human-derived and can be used for this purpose. The use of HuGentra supports hiPSC-differentiation into cell types of the three lineages showing its regenerative capacity.

In summary, the use of stem cells is an exciting field that offers promising hope for developing therapies for diseases such as diabetes, multiple sclerosis, and Parkinson's Disease. These cells have the ability to differentiate into the specified cell type, function normally, and perhaps even regenerate healthy tissue alleviating the disease. It is of great importance to understand the mechanisms that allow these cells to act the way they do. LifeNet Health LifeSciences can help provide researchers with the tools, including different types of primary cells, necessary for making great advances in this field. We look forward to the promising steps that will be made in stem cell research in the future.

References:

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