**Advancing Regenerative Medicine with Stem Cells**

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 **Stem cells have very unique properties that allow them to become a specialized cell for repairing issues in the body. Stem cells can also stay unspecialized, continue multiplying and wait to be assigned to a more specialized function (National Institutes of Health, 2016). Most stem cells are found in embryos and some stem cells, called somatic cells, are found in adults. A third type of stem cell is the mesenchymal stem cell. This third stem cell resides in bone marrow. The only issue with using stem cells found in embryos is where they come from. When it comes to human embryos it raises concern, are these embryos considered morally human beings or not. There is also the issue that the body will reject the stem cells. Though there can be controversy with using embryonic stem cells and the possibility of rejection in the body, stem cell research is extremely important because of all the different abilities that stem cells have. An unspecialized cell can be very beneficial to the world of regenerative medicine. This unspecialized cell could be used to repair, as well as grow new tissue for damaged nerves, organs, or bones.**

**Introduction**

Stem cells are certain cells found throughout the body during the beginning stages of life as well as in some places as an adult. Stem cells could become specialized cells for organs or other parts of the body. There are many different types of stem cells. Three important ones are embryonic, somatic cells and mesenchymal stem cells. The first type of stem cell resides in an embryo that is awaiting instruction to create the many different organs and tissues that make up a human fetus. If the embryonic stem cells clump up they become embryoid bodies and begin to differentiate. (National Institutes of Health, 2016). The second resides in an adult human. The third resides in bone marrow and other muscle and skeletal tissue. Mesenchymal stem cells are responsible for the growth of bone, cartilage, and tendons. (Suk-Kee Tae, Seok-Hyn Lee et al). One study from S.M. Hosseini, M. Sani et al, touches on the advances in neural damage treatment options, in hopes to create a treatment that can repair damaged nerves in spinal cord injuries.

**Recent Progress**

In the article by S.M. Hosseini, M. Sani et al, they experimented on rats to see if combining two different types of stem cells could possibly aid in repairing a spinal cord injury. The two types of stem cells that they chose to use were, mesenchymal and neural stem cells. Mesenchymal stem cells are mostly stem cells that become bone, cartilage, and fat. “The highest neurological recovery was observed in the animals of combined treatment group-5 which showed significantly higher neurological outcome in comparison to all other animal groups” (Hosseini et al.,2017). In the study they had multiple groups of rats: no treatment, a group who underwent spinal cord injury surgery with no treatment, a group that received mesenchymal stem cells one day after surgery, one that only received neural stem cells a day after surgery, and one group that received both. The group that received both mesenchymal and neural stem cells had the most neural activity out of the groups. They also mention how cell-based therapy for different disorders is gaining popularity for treating neurological disorders hoping to repair damaged neurological structures. It is extremely hard to repair spinal cord injuries because the neurogenic pathways are being disrupted causing the pathways to wear down significantly (Hosseini et al.,2017). According to the “National Institutes of Health”, stem cells may one day be able to treat heart disease as well. Cardiovascular disease deprives the heart of oxygen, which in turn kills cardiac muscle cells. (National Institute of Health, 2016). If embryonic stem cells that have been differentiated to create cardiac muscle cells, or mesenchymal stem cells that specialize in creating muscle tissue, could be injected to replace the diseased cardiac muscle. When these stem cells are injected into a person’s circulation or heart tissue there appears to be improvement in the function of the heart (National Institutes of Health, 2016). This method however is variable in subjects and is not a cure for a heart disease. In an article by Suk-Kee Tae, Seok-Hyn et al, there was evidence of mesenchymal stem cells being used in orthopedic studies to repair bone defects. When mesenchymal stem cells were injected into the joint of an animal with osteoarthritis, the cells grew and regenerated meniscal tissue (Suk-Kee Tae, Seok-Hyn Lee et al). Mesenchymal cells are not only used to create bone tissue, these stem cells are also used to repair cartilage, tendons, ligaments and craniotomy defects. (Suk-Kee Tae, Seok-Hyn Lee et al). Cartilage damage seems to be the hardest injury to repair. Cartilage has poor regenerative capacity and its replacement tissue is also poor (Suk-Kee Tae, Seok-Hyn Lee et al). The cartilage is a great candidate to try mesenchymal stem cells on by engineering a fabricated replacement for the spot of injury (Suk-Kee Tae, Seok-Hyn Lee et al). When mesenchymal stem cells are combined with hybrid scaffolding of synthetic and natural polymers the delivery of the stem cells is effective, however problems with purity is concerning (Suk-Kee Tae, Seok-Hyn Lee et al).

**Discussion**

The articles addressed in this paper seem to have very valid ideas on where stem cells could lead humans in the future in regenerative medicine. The article “Concomitant Use of Mesenchymal Stem Cells and Neural Stem cells for Treatment of Spinal Cord Injury: A Combo Cell Therapy approach” and “Mesenchymal stem cells for tissue engineering and regenerative medicine”, addresses the possibility of one day using stem cells to cure spinal, neural, muscular, or bone injuries. This idea is valid however, there are many obstacles to go through before finally being able to cure a spinal injury or bone defects. Some obstacles include the rejection of the cells from the donor, or the failure of the cells because the neural damage in the spine is too great. These articles seem to be headed in the right direction with the result of the combined stem cell group doing the best in a neurological test as well as the positive result with the osteoarthritis meniscal tissue. The question being left unanswered is how much farther is there to go before stem cells can repair neural injuries, or any major injury for that matter. The third article from “National Institutes of Health” mentions stem cells being used in treatment for heart issues. To which some of the trials were successful and some were not. The varying results in each patient, as well as varying strategies, makes this article a little less valid then the first, yet it is still a step in progressing regenerative medicine. Currently the dream of using any type of stem cell for all diseases and injuries is quite far off. There are many obstacles that doctors and researchers are facing. Obstacles researchers are facing are: the ability to differentiate into the desired cell type correctly, integrating the new stem cell tissue into the already existing tissue, and making sure the new cells last the patient’s life time (National Institute of Health, 2016). That does not mean the research has ceased. Currently there are clinical trials for transplantation of retinal pigment epithelial cells to the eye that replace macular degeneration (ISSCR, 2017). Stem cells are on the way to being used to treat many diseases and injuries.

**References**

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