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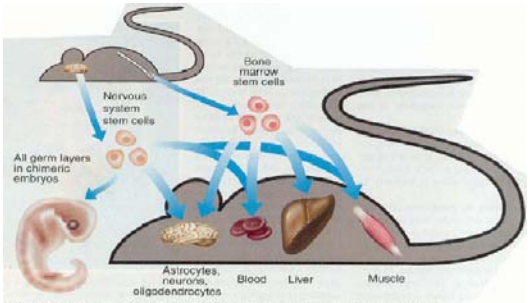
The Hematopoietic Stem Cell Therapy for Exploration of Space

Growing evidence indicates that hematopoietic stem cells (HSCs) possess extraordinary plasticity to differentiate not only to all types of blood cells, but also to various tissues, including bone, muscle, skin, liver and neuronal cells. Therefore, this proposal hypothesizes that the hematopoietic stem cell-based therapy, herein called the hematological abnormalities, bone and muscle losses in space, thereby maintaining astronauts' homeostasis. Our expertise lies in recombinant adeno-associated virus (rAAV)-mediated gene therapy for the hemoglobinopathies, β-thalassemia and sickle cell disease. As the requisite steps in this procedure, we established methods for purification and culture of HSCs in 1 G. Additionally, the NASA Rotating Wall Vessel (RWV) culture system is being optimized for the HSC growth/expansion. Thus, using these technologies, the above hypothesis will be tested as follows: (1) β-thalassemic mouse will be transplanted with normal isologous HSCs to correct the hematological abnormalties; (2) transgenic HSCs harboring green fluorescent protein (GFP) gene or β-galactosidase gene will be transplanted to hindlimb suspended mice, and differentiation of HSCs to bone will be traced by the marker gene expression. Repair/prevention of bone loss by the HSCT will be investigated by analyzing physical/biochemical parameters; and (3) similarly, the efficacy of HSCT for muscle loss in the unloaded mouse will be studied. In addition, using the hindlimb suspension model, effect of exercise on the HSCT for bone and muscle losses will be investigated. Our long-term goal is to automate/robotize the HSCT protocols so that astronauts would be able to treat themselves during long-duration space missions. Such a program will also be beneficial to Earth people as a self-care health system.



A web of possibility. In mice, stem cells from adult brain and bone marrow have shown encouraging potential for repairing a variety of tissues and organs and perhaps curing disease.