Research Projects on Aging

Growing pains take on new meaning as we near the end of our life cycle. The physical changes that come with aging are a natural part of being human, yet what causes the body to decline over time is still poorly understood.

Biologists say that aging is difficult to study because of its complexity, with different parts of our bodies undergoing slow and steady, but sometimes rapid, change with advancing years. What is known is that aging is related to the decline in the body’s ability to regenerate new tissue, causing joints, blood vessels, and other parts of our anatomy to function differently than they do when we are younger.

New evidence indicates that a progressive decline in stem cell frequency and function may significantly contribute to the conditions related to aging, but it is not known why this is.
A Multi-Disciplinary Approach

Scientists at the Harvard Stem Cell Institute (HSCI) are studying the aging process in multiple organ systems (muscular, circulatory, nervous, etc.) in order to better understand how we age and develop potential therapeutic interventions.

Skeletal Muscle

Skeletal muscle is any muscle attached to our bones that we use to move. The regeneration of skeletal muscle relies on the life-long maintenance of a naturally occurring population of stem cells called satellite cells, which repair muscle.

Skeletal muscle weakens during aging largely due to defects in satellite cells. As we age, functional skeletal muscle tissue starts to be replaced by fatty and fibrous tissue causing an acquired muscle atrophy known as sarcopenia. This condition is similar to muscle loss in congenital muscle diseases, such as muscular dystrophy, where satellite cells struggle to keep up with the constant death of genetically deficient muscle fibers.

HSCI scientists are using interdisciplinary and cross-species approaches to learn which regulatory defects in satellite cells affect their ability to self-renew. One research effort led to the identification of new genetic pathways that control the formation of muscle tissue. Another study discovered a class of small molecules that could potentially assist in muscle repair for aged, as well as younger, skeletal muscle.

Heart and Blood

The science behind skeletal muscle decline can also be applied to other tissue types. A recent collaboration between HSCI faculty studying heart function in aged and young mice led to the identification of a protein that literally could reverse many age-associated cardiac problems. Increasing the level of this protein that typically declines with age may have positive “rejuvenation” effects on other organs as well, suggesting possible commonalities in the aging process in distinct tissues and organs. HSCI scientists are in discussion with potential external collaborators to move this work from mouse to human cells, with the goal of developing new treatments.

Scientists are also learning how red and white blood stem cells change as we age. A decrease in T-cell production may be responsible for a decline in immune functions over time; and a dysfunction in the way blood cells are produced could explain why the elderly are more susceptible to bone marrow diseases, such as chronic myelogenous leukemia. Understanding how to manage such diseases and dysfunctions should lead to new therapeutic options and strategies.

Other Diseases

Aging is also associated with Alzheimer’s, Parkinson’s, cancer, and many other illnesses. The key to understanding these diseases lies in our increasing ability to know what happens at the cellular level, which, in turn, leads to our ability to intervene with new therapeutic options. Stem cells are not the “fountain of youth,” but they can help us find the causes of disease and reveal new strategies for repair that help people live healthier, more productive lives.

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