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The Effect of Natural Background Radiation on Stem Cell Biology - (in-person)

Wednesday, 21 August 2024 09:00 (30 minutes)

20-minute talk + 10-minute questions

A number of experiments have shown that cells grown under chronic and/or acute low doses of radiation exhibit growth and fitness traits different from cells grown at control radiation levels, suggesting a radioadaptive response. Adult stem cells are a rare population of undifferentiated cells located within a differentiated organ or tissue, in a specialized structure called a niche. These niches maintain the local microenvironments that regulate the growth and development of stem cells. Adult stem cells have the capacity to self-renew and can differentiate into a limited number of mature cell types. The main role of adult stem cells is to maintain tissue homeostasis. These cells are normally maintained in a quiescent state but can be activated to proliferate and differentiate into the required cell types upon the loss of cells or injury to the tissue. Adult stem cells have been identified in many tissues, including bone marrow, intestine, skin, muscle, brain, and heart. Due to their long lifespan, adult stem cells may sustain several rounds of radiation damage that, individually, may not have a significant impact on cellular physiology. However, collectively, these rounds of radiation damage may severely affect cellular function. Following damage, cells may properly repair DNA and re-establish functionality, but if DNA damage is extensive, cells may accumulate irreversible damage that triggers either apoptosis or senescence. Senescence is a process that induces permanent cell cycle arrest with a loss of cellular functions and may produce various biological outcomes. The senescence of stem cells could be very deleterious as it can greatly impair tissue homeostasis and repair. Alternatively, cells with unrepaired damage may sustain mutations and undergo malignant transformation. Given that humans are constantly exposed to low-dose radiation (IR) in the environment from natural backgrounds, the effect induced by IR on the biology of adult stem cells could have deleterious consequences for the whole organism. Despite the significant attention the scientific community has bestowed upon adult stem cells, little is known about the effects of low-dose IR on tissue stem cells. On these premises, we aim to investigate the effect of natural background radiation on key aspects of stem cell biology (i.e., DNA repair capacity and senescence). Our intention is to perform experiments on a specific kind of adult stem cell, namely mesenchymal stromal/stem cells (MSCs). This choice is due to the following reasons: MSCs, present in most stromal tissues, are a heterogeneous population containing multipotent stem cells, progenitors, and differentiated cells. MSCs can differentiate into mesodermal progeny, such as osteocytes, chondrocytes, adipocytes, and muscle cells. In the human body, the impairment of MSC activities has huge repercussions on health, given their key role in tissue and organ homeostasis. These properties have also been exploited in MSC-based cell therapy.

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Session Classification: Studies of Life in Low Background Radiation