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Asymmetric Self-Renewal: The fundamental property of tissue stem cells is the fundamental principle for their medical engineering

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Tissue stem cells do more than “self-renew and differentiate.” In fact, this commonly applied description may often be erroneous. Some tissue stem cells may never differentiate. Instead they divide to produce lineage-committed differentiating cells while retaining their own stem cell state. This remarkable capability is asymmetric self-renewal. Asymmetric self-renewal may be accomplished by either of two distinctive types of cell kinetics programs. Individual tissue stem cells may undergo determined asymmetric cell divisions that produce a stem cell sister and a lineage-committed sister; or small pools of stem cells may divide to produce stochastically either two sister stem cells or two lineage-committed cells. Both cell kinetics programs can achieve the same essential feature of vertebrate tissues, mature cell differentiation without loss of the cell development program. Increased application of the principle of tissue stem cell asymmetric self-renewal will accelerate success in engineering of human tissue stem cells for medical innovations. Asymmetric self-renewal poses an intrinsic challenge to production of tissue stem cells for use in cell replacement therapies like diabetes, anemias, liver failure, and tissue injuries. As a unique cellular process that defines tissue stem cells universally, asymmetric self-renewal is an ideal biomarker for quantitative dosing of tissue stem cells. Similarly, the unique cell kinetics output of tissue stem cells projects a unique cell growth signature that can be used to monitor tissue stem cells for novel drug evaluation assays. Such recent advances in tissue stem cell medical engineering based on the fundamental principle of asymmetric self-renewal will be presented.

Biography

James Sherley graduated from Harvard College (1980) and completed joint M.D./Ph.D. degrees at the Johns Hopkins University School of Medicine (1988). After post-doctoral studies at Princeton University, beginning in 1991 he led cancer cell molecular biology research at Fox Chase Cancer Center. In 1998, he began adult stem cell research at Massachusetts Institute of Technology, and in 2007 continued at Boston Biomedical Research Institute. In 2013, he founded Asymmetrex, LLC (previously the Adult Stem Cell Technology Center, LLC), which he currently directs. Asymmetrex develops technologies for stem cell medicine, including mass-producing tissue stem cells for applications in drug development and regenerative medicine.

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