Stem cells and their niche in homeostasis/regeneration and disease

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The Minisymposium "Stem Cells and Their Niche in Homeostasis/Regeneration and Disease" was aimed at highlighting the importance of cell biology aspects in understanding stem cell biology.

Tudorita (Doina) Tumbar (Cornell University) started the session by summarizing two models of stem cell behavior during normal homeostasis. Stem cells can divide asymmetrically to generate a stem cell and a more differentiated cell. Conversely, she showed that hair follicle stem cells behave as a population: some differentiate and eventually die, while others self-renew by symmetric divisions. During hair follicle stem cell G_0 quiescence, the transcription factor Runx1 drives a reversible step of differentiation to progenitors. The latter succumb irreversibly to rapid proliferation and terminal differentiation upon activation of tissue signals.

Pantelis Rompolas (Valentica Greco's Lab, Yale University) reported evidence for a direct link between a specific niche location and cell fate, using in vivo imaging to trace single hair-follicle stem cells long term in live mice. Furthermore, by utilizing laser ablation, he showed that hair follicle stem cells may be dispensable and that other epithelial populations can be reprogrammed to support hair regeneration by entering the niche.

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Gage Crump (University of Southern California) presented evidence for a transfating of chondrocytes to the osteoblasts that rebuild bone during jawbone regeneration in zebrafish. Such transfating is not observed during development of the same bone, challenging the notion that adult regeneration of an organ simply recapitulates its development. He also presented evidence for a novel role of Ihh signaling in this process and for a similar process in mammalian bone regeneration.

Heike Kroeger (Jonathan Lin's Lab, University of California, San Diego) presented a study that links unfolded protein response signaling to hESC differentiation and maturation via the function of ATF6. hESC activates the ATF6 signaling during hESC differentiation through the FGF2 signaling cascade. ATF6 signaling leads to dramatic expansion of the endoplasmic reticulum (ER) and enhances hESC differentiation. These findings provide a new mechanism underlying hESC differentiation that involves ATF6's induction and activation of ER functions.

Daniela Malide (National Institutes of Health) reported the use of combinatorial 5 fluorescent proteins to mark hematopoietic stem and progenitor cells that allowed in vivo clonal tracking via confocal and two-photon microscopy, providing insights into bone marrow hematopoietic architecture during regeneration. This method allowed noninvasive fate mapping of multicolored hematopoietic stem/progenitor cell–derived cells in intact nonhematopoietic tissues for extensive periods of time following transplantation, demonstrating clearly delineated clones progressing from multicolored to monochromatic over time.

Abby Gerhold (Paul Maddox's Lab, University of North Carolina, Chapel Hill) reported in vivo live imaging of *Caenorhabditis elegans* germ-line stem cells to investigate how mitotic progression is influenced by the physiological context. She provided evidence that 1) the duration of chromosome congression is reduced during developmental expansion of the stem cell pool, and 2) dietary restriction induces a spindle assembly checkpoint–dependent delay in anaphase onset, suggesting the basic mitotic process is affected by physiological factors.

Yukiko Yamashita (University of Michigan, Ann Arbor) discussed her group's recent identification of Klp10A kinesin as the first stem cell–specific centrosomal component in the *Drosophila* male germ line. Klp10A seems to specifically regulate the length of stem cells' mother centrosomes. She presented additional data suggesting Klp10A regulates stem cell behavior through the regulation of nanos mRNA.