Researchers discover cellular structure that explains fate of stem

July 9, 2015

Researchers have found a previously unidentified mechanism that helps explain why stem cells undergo self-renewing divisions but their offspring do not.

Adult stem cells provide a ready supply of new cells needed for tissue homeostasis throughout the life of an organism. Specialized environments called “niches” help to maintain stem cells in an undifferentiated and self-renewing state. Cells that comprise the niche produce signals and growth factors essential for stem cell maintenance. The mechanisms that allow for reception of these signals exclusively by stem cells and not their more specialized progeny remain poorly understood.

“This finding stands to change the way we think about how stem cells and their neighbors communicate with one another,” said Michael Buszczak, Ph.D., associate professor in the c Department of Molecular Biology and with the Hamon Center for Regenerative Science and Medicine.

The findings are presented in the journal *Nature*.

Scientists have been working to understand how the signaling between niches and stem cells works.

“These signals act over a short range, so only stem cells − but not their differentiating progeny − receive the self-renewing signals,” said Dr. Buszczak. “The mechanics of this communication were not known. What we discovered was that the stem cells form microtubule-based nanotubes, which extend into the niche. These threadlike nanotubes act like straws to tap into the niche and allow signaling to occur specifically in the stem cell.”

The findings emanate from an active collaboration between the Buszczak lab at UT Southwestern and the lab of Yukiko Yamashita, Ph.D., at the University of Michigan. Dr. Yamashita is an associate professor of cell and developmental biology at the University of Michigan Life Sciences Institute and a Howard Hughes Medical Institute (HHMI) Investigator.

First author Mayu Inaba, a postdoctoral research fellow at the Life Sciences Institute and a visiting senior fellow in molecular biology at UT Southwestern in the Buszczak lab, noticed thin projections linking individual stem cells back to a central hub in the stem cell “niche.” Dr. Yamashita looked through her old image files and identified the same connections in numerous images. “I had seen them, but I wasn’t seeing them,” Dr. Yamashita said. Dr. Inaba worked to further develop the project as a senior research fellow in the Buszczak lab over the last several years.

The findings are important groundwork for understanding how stem cells reproduce and how miscommunication between cells can result in diseases like cancer. Too much stem cell production, for example, can lead to cancerous growth. Too little reproduction can result in inadequate renewal of cells and underlies the aging process.

The long-term goal of [Dr. Buszczak’s lab](http://www4.utsouthwestern.edu/buszczaklab/index.html) is to determine the complete regulatory network that controls both the maintenance of Drosophila stem cells and the differentiation of their daughters.

“We hope to use this information as a foundation for understanding how perturbations in normal gene expression programs cause disease,” Dr. Buszczak said.

*Learn more:*<http://www.utsouthwestern.edu/newsroom/news-releases/year-2015/july/stem-cell-buszczak.html>doi:10.1038/nature14602