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NEWS

Blood and bone: shedding light on the critical role of stem cells found deep within our skeleton

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Webinar: The impact of the hematopoietic stem cell niche on the maintenance and function of the skeleton.

Our skeleton supports us as we move and protects our organs. However, it is more than just a structural scaffold. Within the bone marrow is a special group of stem cells. They can reproduce indefinitely and have special functions, such as producing blood and controlling bone regeneration.

Scientists are particularly interested in the conditions that help these bone marrow stem cells (also called haematopoietic stem cells, or HSCs) to reproduce. The signalling molecules and cell types found here are collectively called the 'stem cell niche'.

Laura Calvi, at the University of Rochester Medical Center in Rochester, New York, has been studying the HSC niche for many years. She is particularly interested in the role of signals from the bone itself in producing and maintaining the viability and function of HSCs[1]—something that scientists have been actively studying for only the last decade and a half. Insights from Calvi's team have shown that not all bone marrow niches are the same, nor are the types of cells within them. The variation among the stem cells and their niche is a growing area that scientists must consider. It is critical to understand the neighbourhood in which these cells live, how they communicate with other cells in their niche and how they are able to return to the niche when in circulation.

If scientists can understand what happens in the niche, then regenerating these important cells after disease or injury becomes feasible. The bone marrow stem cell environment is altered by many factors: by diseases like leukaemia, radiation from cancer therapy or space flight, physical injury such as bone fracture, and even ageing. Therefore, it is critical to understand more about how the bone niches and their precious cargo work together, to help provide an unlimited therapeutic supply of HSCs.

In this webinar, Calvi discussed the complexity of the niche environment and the effects on HSCs of different signalling molecules and perturbations. She also provided clues as to how scientists might stimulate the niche and thus indirectly control stem cell proliferation.

Her lab has shown, for example, that a hormone involved in bone growth—parathyroid hormone, or PTH—increases the number of HSCs. Calvi and her team administered PTH to mice the same way that a drug is given to patients, and also studied genetically engineered mice that have more PTH receptors than average.[2] In both cases they found that PTH boosted the number of HSCs.

Calvi also described another set of more recent studies in which she and her colleagues examined the effects of leukaemia on bone. They showed that leukaemia, which is a cancer of the blood, hijacks the stem cell niche. It kills off the normal bone progenitor cells, resulting in bone loss in mice and, crucially, the decreased ability of the HSC niche to produce blood cells as usual.[3] The team is now studying a molecule (called CCL3) that they think may be responsible for some of the effects of leukaemia in mice and humans.

HSCs come from bone, and therefore it is not entirely unexpected that they may also be important in maintaining the skeleton. Calvi discussed the recent work from Laurie McCauley's lab at the University of Michigan that suggests that cells from the bone marrow—particularly a population of cells called osteal macrophages—help to remodel the skeleton, a process that builds new bone and removes the old. New data suggest that such cells are particularly important for the recovery of bone and bone marrow following radiation damage.

For more details on HSCs and their interaction with the skeleton, watch the accompanying webinar at http://www.nature.com/bonekey/webinars/index.html?key=webinar32

Edited by LJ Suva

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