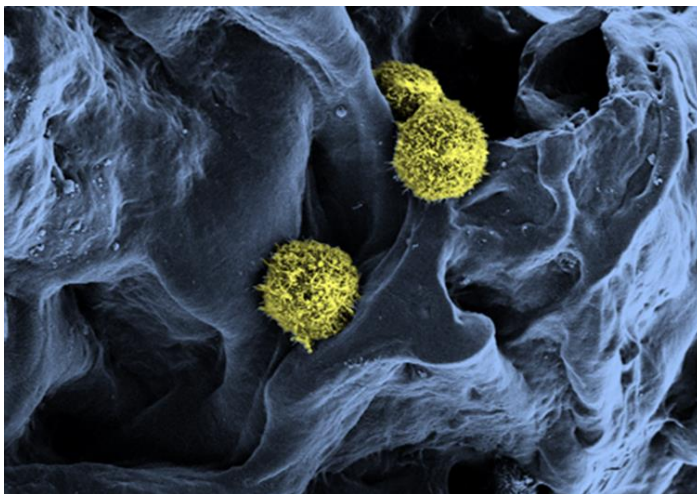


KIT Researchers Develop Artificial Bone Marrow

Specific Reproduction of Hematopoietic Stem Cells outside of the Body Might Facilitate Therapy of Leukemia in a Few Years



Scanning electron microscopy of stem cells (yellow / green) in a scaffold structure (blue) serving as a basis for the artificial bone marrow. (Photo: C. Lee-Thedieck/KIT)

Artificial bone marrow may be used to reproduce hematopoietic stem cells. A prototype has now been developed by scientists of KIT, the Max Planck Institute for Intelligent Systems, Stuttgart, and Tübingen University. The porous structure possesses essential properties of natural bone marrow and can be used for the reproduction of stem cells at the laboratory. This might facilitate the treatment of leukemia in a few years. The researchers are now presenting their work in the “Biomaterials” journal (DOI: 10.1016/j.biomaterials.2013.10.038).

Blood cells, such as erythrocytes or immune cells, are continuously replaced by new ones supplied by hematopoietic stem cells located in a specialized niche of the bone marrow. Hematopoietic stem cells can be used for the treatment of blood diseases, such as leukemia. The affected cells of the patient are replaced by healthy hematopoietic stem cells of an eligible donor.

However, not every leukemia patient can be treated in this way, as the number of appropriate transplants is not sufficient. This problem

Monika Landgraf
Chief Press Officer

Kaiserstraße 12
76131 Karlsruhe, Germany
Phone: +49 721 608-47414
Fax: +49 721 608-43658
E-mail: presse@kit.edu

**For further information,
please contact:**

Kosta Schinarakis
PKM – Science Scout
Phone: +49 721 608 41956
Fax: +49 721 608 43658
E-mail: schinarakis@kit.edu

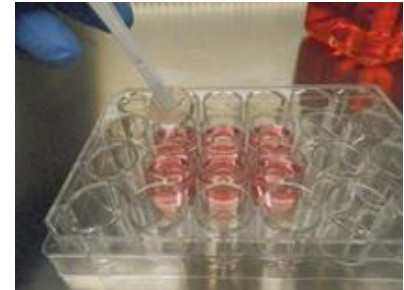
might be solved by the reproduction of hematopoietic stem cells. So far, this has been impossible, as these cells retain their stem cell properties in their natural environment only, i.e. in their niche of the bone marrow. Outside of this niche, the properties are modified. Stem cell reproduction therefore requires an environment similar to the stem cell niche in the bone marrow.

The stem cell niche is a complex microscopic environment having specific properties. The relevant areas in the bone are highly porous and similar to a sponge. This three-dimensional environment does not only accommodate bone cells and hematopoietic stem cells but also various other cell types with which signal substances are exchanged. Moreover, the space among the cells has a matrix that ensures a certain stability and provides the cells with points to anchor. In the stem cell niche, the cells are also supplied with nutrients and oxygen.

The Young Investigators Group “Stem Cell–Material Interactions” headed by Dr. Cornelia Lee-Thedieck consists of scientists of the KIT Institute of Functional Interfaces (IFG), the Max Planck Institute for Intelligent Systems, Stuttgart, and Tübingen University. It artificially reproduced major properties of natural bone marrow at the laboratory. With the help of synthetic polymers, the scientists created a porous structure simulating the sponge-like structure of the bone in the area of the blood-forming bone marrow. In addition, they added protein building blocks similar to those existing in the matrix of the bone marrow for the cells to anchor. The scientists also inserted other cell types from the stem cell niche into the structure in order to ensure substance exchange.

Then, the researchers introduced hematopoietic stem cells isolated from cord blood into this artificial bone marrow. Subsequent breeding of the cells took several days. Analyses with various methods revealed that the cells really reproduce in the newly developed artificial bone marrow. Compared to standard cell cultivation methods, more stem cells retain their specific properties in the artificial bone marrow.

The newly developed artificial bone marrow that possesses major properties of natural bone marrow can now be used by the scientists to study the interactions between materials and stem cells in detail at the laboratory. This will help to find out how the behavior of stem cells can be influenced and controlled by synthetic materials. This knowledge might contribute to producing an artificial stem cell niche for the specific reproduction of stem cells and the treatment of leukemia in ten to fifteen years from now.



A synthetic scaffold structure similar to the bone is placed into a vessel for the cultivation of stem cells. (Photo: C. Lee-Thedieck/KIT)

Annamarija Raic, Lisa Rödling, Hubert Kalbacher, Cornelia Lee-Thedieck: Biomimetic macroporous PEG hydrogels as 3D scaffolds for the multiplication of human hematopoietic stem and progenitor cells. Biomaterials. DOI: 10.1016/j.biomaterials.2013.10.038

Karlsruhe Institute of Technology (KIT) is a public corporation according to the legislation of the state of Baden-Württemberg. It fulfills the mission of a university and the mission of a national research center of the Helmholtz Association. Research activities focus on energy, the natural and built environment as well as on society and technology and cover the whole range extending from fundamental aspects to application. With about 9000 employees, including nearly 6000 staff members in the science and education sector, and 24000 students, KIT is one of the biggest research and education institutions in Europe. Work of KIT is based on the knowledge triangle of research, teaching, and innovation.

This press release is available on the internet at www.kit.edu.

The photos of printing quality may be downloaded under www.kit.edu or requested by mail to presse@kit.edu or phone +49 721 608-47414. The photos may be used in the context given above exclusively.