Fat tissue may be a source of valuable blood stem cells, study says

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Bone marrow is a leading source of adult stem cells, which are increasingly used for research and therapeutic interventions, but extracting the cells is an arduous and often painful process. Now, researchers have found evidence that fat tissue, known as adipose tissue, may be a promising new source of valuable and easy-to-obtain regenerative cells called hematopoietic stem and progenitor cells (HSPCs), according to a study prepublished online in *Blood*, the official journal of the American Society of Hematology.

"It's not outside the realm of possibility that a donor graft of adipose tissue-derived HSPCs might be able to partially replace the need for bone marrow transplantation within 10 years," said lead study author Gou Young Koh, MD, PhD, of the Department of Biological Sciences, Korea Advanced Institute of Science and Technology (KAIST) in Daedeok Science Town, Daejeon, South Korea.

HSPCs are powerful cells that have the ability to regenerate and develop into many different kinds of cells. With advances in technologies and understanding of cell functions, HSPCs are now used to repair damaged tissue and are being studied for their potential to treat a vast array of chronic and degenerative conditions. HSPCs are found in high quantities in the bone marrow, but a certain portion known as extramedullary tissue, found outside of bone marrow, circulate between the marrow and the peripheral blood.

Previous research has found that adipose tissue contains many different

types of adult stem cells. In this study, researchers hypothesized that the adipose tissue might be a valuable alternative source of HSPCs as an extramedullary tissue but questioned whether the tissue could provide a sufficient quantity of cells to be used for research and therapeutic purposes.

"We know that adipose tissue and bone marrow tissues share similar properties, so we suspected that valuable stem cells might be found in the adipose regions, offering a unique resource for stem cells that might be easier and less costly to extract," said Dr. Koh.

Within the adipose tissue is a special cell population known as the stromal vascular fraction (SVF), which consists of other undefined stem cells as well as immune, endothelial (blood vessel lining), progenitor (undifferentiated or premature precursor cells), and stromal (connective tissue) cells. Cells in the SVF share similar properties to those in the bone marrow. Both contain a population of cells that have the ability to differentiate into several cell types. In addition, both adipose tissue and bone marrow offer similar
environments for optimal stem cell growth and reproduction, including a smaller amount of circulating oxygen and specialized vascular systems as compared with other organs.

The research team characterized the HSPCs in the SVF of mouse adipose tissue with both *in vitro* and *in vivo* analyses. They studied the origin of the HSPCs to better predict their behavior and determine whether the quantity of cells could be increased by promoting more frequent HSPC movement between the bone marrow and peripheral blood using granulocyte colony-stimulating factor, or G-CSF, a growth hormone used to encourage development of stem cells. The team found that the more they could mobilize the HSPCs between the bone marrow and the peripheral blood, the more HSPCs they would find in the SVF.

The study results provide compelling evidence that the SVF derived from adipose tissue contains functional HSPCs capable of generating hematopoietic (blood-forming) cells. Importantly, researchers found that the cells were able to differentiate into a variety of hematopoietic cells when tracked for at least 16 weeks post-transplantation, which reflects long-term and permanent reconstitution of donor hematopoietic cells in recipients.

The frequency of HSPCs in the adipose tissue found in the study was significantly less than that found in bone marrow (approximately 0.2 percent of the HSPCs found in total bone marrow). Therefore, researchers wanted to determine whether the SVF might be used practically as an alternative source of HSPCs. Fortunately, according to the researchers, a vast amount of the SVF in adipose tissue can be easily obtained from patients using conventional liposuction and isolation methods that are safe and relatively pain-free.

"These study results suggest that more HSPCs might be obtained from the stromal vascular fraction through increased mobilization of these cells from the bone marrow using G-CSF," said Dr. Koh. "So once a technology can be defined to purify HSPCs from the stromal vascular fraction, we believe adipose tissue may be a good alternative and novel resource for obtaining functional and transplantable HSPCs."

The research team is actively extending their research in this area, including plans for a human clinical study. They also emphasize the need for a clinically safer and more efficient method for isolating the HSPCs from the adipose tissue.

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