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Researchers identify novel approach to create red blood cells, platelets in vitro

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A study led by Boston University School of Medicine has identified a novel approach to create an unlimited number of human red blood cells and platelets in vitro. In collaboration with Boston University School of Public Health (BUSPH) and Boston Medical Center (BMC), the researchers differentiated induced pluripotent stem (iPS) cells into these cell types, which are typically obtained through blood donations. This finding could potentially reduce the need for blood donations to treat patients requiring blood transfusions and could help researchers examine novel therapeutic targets to treat a variety of diseases, including sickle cell disease.

Published online in the journal *Blood*, the study was led by George J. Murphy, PhD, assistant professor of medicine at BUSM and co-director of the Center for Regenerative Medicine (CReM) at Boston University and BMC and performed in collaboration with David Sherr, PhD, a professor in environmental health at BUSM and BUSPH.

iPS cells are derived by reprogramming adult cells into a primitive stem cell state that are capable of differentiating into different types of cells. iPS cells can be generated from mature somatic cells, such as skin or blood cells, allowing for the development of patient-specific cells and tissues that should not elicit inappropriate immune responses, making them a powerful tool for biological research and a resource for regenerative medicine.

In this study, the iPS cells were obtained from the CReM iPS Cell Bank.

The cells were exposed to growth factors in order to coax them to differentiate into red blood cells and platelets using a patented technology. These stem cells were examined in depth to study how blood cells form in order to further the understanding of how this process is regulated in the body.

In their new approach, the team added compounds that modulate the aryl hydrocarbon receptor (AhR) pathway. Previous research has shown this pathway to be involved in the promotion of cancer cell development via its interactions with environmental toxins. In this study, however, the team noted an exponential increase in the production of functional red blood cells and platelets in a short period of time, suggesting that AhR plays an important role in normal blood cell development.

"This finding has enabled us to overcome a major hurdle in terms of being able to produce enough of these cells to have a potential therapeutic impact both in the lab and, down the line, in patients," said Murphy. "Additionally, our work suggests that AhR has a very important biological function in how blood cells form in the body."

Blood transfusion is an indispensable cell therapy and the safety and adequacy of the blood supply is an international concern. In 2009, the National Blood Data Resource Center reported that blood-banking institutions collected more than 17 million units of whole blood and red blood cells and US hospitals were transfusing more than 15 million patients annually. Given the variety of blood types, there are – even in developed countries – chronic shortages of blood for some groups of patients. Sporadic shortages of blood also can occur in association with natural or man-made disasters. The number of blood transfusions is expected to increase in people over the age of 60 and could lead to an insufficient blood supply by 2050.

"Patient-specific red blood cells and platelets derived from iPS cells,

which would solve problems related to immunogenicity and contamination, could potentially be used therapeutically and decrease the anticipated shortage and the need for blood donations," added Murphy.

iPS-derived cells have great potential to lead to a variety of novel treatments for diseases given that they can be used to construct disease models in a lab. The iPS-derived red blood cells could be used by researchers examining malaria and sickle cell anemia while the iPS-derived platelets could be used to explore cardiovascular disease and treatments for blood clotting disorders.

More information: bloodjournal.hematologylibrary … 2-11-466722.abstract

Provided by Boston University Medical Center