New type of blood stem cell could help solve platelet shortage

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Scientists funded by the Medical Research Council (MRC) have identified a new type of bone marrow stem cell in mice that is primed to produce large numbers of vital blood-clotting platelets. The breakthrough may eventually lead to the development of new treatments to restore platelets in patients who have undergone chemotherapy or a bone marrow transplant. The research, published in *Nature*, was led by the MRC Weatherall Institute of Molecular Medicine (WIMM), at the University of Oxford.

Blood cells are made by a small pool of stem cells in the bone marrow, which replenish the blood at a rate of millions of cells per second. These cells can self-renew (copy themselves) and give rise to all the different cell types that make up the blood system, including white and red blood cells, and platelets.

Platelets help the blood to clot by clumping together at the site of bleeding. Having too few platelets can result in excessive bleeding and is a common side effect in cancer patients, whose natural reservoir of platelets has been destroyed by the disease or by treatment. This can be life-threatening in the weeks immediately following chemotherapy or a bone marrow transplant as it takes time for blood stem cells to replenish platelets to safe levels.

Many patients who undergo these treatments are given platelet transfusions to protect them from bleeding. But donated platelets can only be stored for a few days and demand often outstrips supply.

Researchers have therefore been looking for a way to rapidly and durably increase the production of platelets to reduce the risk of bleeding.

Scientists had thought there was just one type of blood stem cell. This study, led by Professors Sten Eirik W Jacobsen and Claus Nerlov, has revealed a previously undiscovered subset of platelet-primed blood stem cells that can self-renew and produce some other cell types that make up the blood, but are particularly geared towards platelet production.

The researchers also found that different subtypes of blood stem cell are organised into a hierarchy, with platelet-primed cells at the top. These platelet-primed cells are able to also replenish other stem cell types that mostly generate the vital blood cells of the immune system.

Transplanting just one platelet-primed stem cell into mice that lacked their own bone marrow was enough to stably restore more than 10 per cent of their platelets, suggesting that these cells can generate a huge number of platelets in a sustainable manner. Future studies by the group will focus on whether or not this can be achieved quickly enough to benefit patients in a clinical transplantation setting.

Professor Sten Eirik Jacobsen from the MRC Molecular Haematology Unit and the Haematopoietic Stem Cell Biology Unit, part of the MRC WIMM at the University of Oxford, said:

"We used to think that there was just one type of blood stem cell that could self-renew and give rise to all the different cell types in the blood. But here we've identified a new type of stem cell that is very driven, at a molecular and functional level, towards making platelets.

"Now that we know these cells exist, we can start thinking about devising new strategies to enhance platelet output – either by generating and

transplanting more of this type of cell into a recipient, or by somehow stimulating their own pool of stem cells to restore platelet levels more quickly. But first we need to see whether we can find the same cells in human tissue and understand more about how they are regulated."

Professor Alastair Poole, a platelet biologist and member of the MRC's Molecular and Cellular Medicine Board, which funded the research, said:

"Blood stem cells were the first ever stem cells to be identified by scientists, but there is still a lot we don't fully understand about how these cells are controlled in the body. The discovery of a distinct class of blood stem cells within the bone marrow adds a great deal to our understanding and sheds light on how platelet generation in the body is regulated.

"Since platelets are key to blood clotting and loss of platelets can lead to potentially life-threatening bleeding disorders, this discovery of a potent platelet-generating stem cell in the bone marrow has exciting potential. It will be important to identify these stem cells in human tissue, because if replicated in humans they may hold the key to new treatments that will benefit patients with cancer and other serious platelet disorders."

Provided by Medical Research Council