Advances in Cryopreservation: Rapid Glycerol Removal in 3 Mins!

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A rendering of a red blood cell. Cryopreservation can prolong the longevity of RBCs from weeks to years. Image credit: [Wikimedia Commons](http://commons.wikimedia.org/wiki/File%3AErythrocyte_deoxy.jpg)

Transfusion of red blood cells (RBCs) has been regarded as a life-saving medical treatment for many years; approximately 85 million units are transfused annually worldwide. Typically, RBCs are preserved through refrigeration, which allows a storage shelf life of up to 6 weeks.[Cyropreservation](http://blog.biocision.com/6635/cryopreservation-long-term) can further prolong the longevity of RBCs from weeks to years. RBCs are frozen with a final concentration of 40% glycerol and stored at temperatures between −60°C and −80°C. Once thawed, a series of washes must be performed to reduce the glycerol content in the RBCs prior to infusion, which can take up to one hour per unit of blood. Thus, cryopreservation of RBCs creates logistical challenges for emergency situations in which transfusions are necessary immediately.

Recently, engineers at Oregon State University reported a new method to rapidly prepare frozen RBCs for transfusions. Current methods for glycerol removal are time consuming due to limitations in how fast glycerol can be removed without damaging the cells. The authors hypothesized that if the extracellular solution is controlled appropriately, glycerol extraction could be completed more rapidly with minimal cell damage. Indeed, they showed that a blood sample could be diluted with a saline solution in multiple steps in the span of three minutes with less than 20% hemolysis [1]. However, this faster procedure requires control over the solution composition at a time scale of seconds, which is not possible using automated centrifuges.

As national leaders in the science of microfluidics, the OSU group has offered a potential solution to improve the cryopreservation process. Their proposed approach is based on the use of a membrane-based, microfluidic device consisting of two microchannels separated by a dialysis membrane [2]. This microfluidic device allows precise control over fluid flow and transfer at the microscale. Computer modeling of the device predicts that a typical hour-long process could be reduced to as little as three minutes. They are currently generating a working prototype of the device for further testing of their approach.

A clinical device for ultra-rapid glycerol removal would significantly improve the logistics of [blood banking](http://blog.biocision.com/9579/biobanking-future-medicine), since it would allow the cryopreservation of RBCs and subsequent, rapid preparation for transfusions as needed.

**References:**

[1]        Lusianti, R. E., Benson, J. D., Acker, J. P. & Higgins, A. Z. [Rapid removal of glycerol from frozen-thawed red blood cells.](http://onlinelibrary.wiley.com/doi/10.1002/btpr.1710/abstract) *Biotechnology progress* **29**, 609-620, doi:10.1002/btpr.1710 (2013).

[2]        Lusianti, R. E. and Higgins, A. Z. [Continuous removal of glycerol from frozen-thawed red blood cells in a microfluidic membrane device](http://scitation.aip.org/content/aip/journal/bmf/8/5/10.1063/1.4900675). *Biomicrofluidics* **8**, 054124, doi:10.1063/1.4900675 (2014).