Fluidic Device for Removal of Extracellular Hemoglobin from Freeze-Dried Blood Products

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Abstract

Hospitals across the nation are in continuous need of new blood donations due to issues with blood sourcing as well as limited shelf-life. Recent innovations in methods for freeze-drying blood products may be able to overcome these blood supply issues, but this approach presents new challenges of its own. The freeze-drying process causes increased hemolysis, leading to the release of intracellular hemoglobin during rehydration. This free hemoglobin is inflammatory and cytotoxic, resulting in organ damage if it is not removed from blood products prior to transfusion. The traditional method to wash free hemoglobin from blood products involves centrifugation, but this equipment may not be available in low-resource environments that could benefit from freeze-dried blood products. In light of these issues, we have designed a centrifuge-free device to wash blood samples, separating the free hemoglobin from the live red blood cells. This prototype system is operated by a syringe pump and consists of a combination of millifluidic tubing and flow splitters designed through additive manufacturing. The centrifugal and viscous forces created by this device enable separation of the red blood cells from their washing fluid, increasing the end red blood cell concentration and siphoning off the washing solution containing free hemoglobin. With modification, this system will present a novel way for ensuring the safety of blood for transfusion in areas that lack resources to acquire technology such as a centrifuge, paving the way for use in extremely remote situations such as military use.

Biography of Presenter

Erica Guelfi is an incoming senior at Vanderbilt University studying Biomedical Engineering. When not learning in class, she can often be found taking 3D scans of cancer samples in the lab she works in. Erica is also part of a medical makeathon club that recently won a global competition for the design of a self-feeding device for children with disabilities. Design is a constant presence in Erica's life, as she is president of Vanderbilt's Design for America chapter, an organization focused on the human-centered design process. In the future, Erica hopes to pursue research in graduate school and continue to grow her knowledge base in biology and engineering.