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mPharesis: Magnetic apheresis device for filtration of malaria-infected red blood cells

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The *Plasmodium falciparum* malaria parasite causes nearly one million deaths per year across over 100 countries. The parasite invades the host's red blood cells (RBC), feeding off of the RBC's hemoglobin and creates a magnetic byproduct within the infected RBCs (iRBC). A low concentration of iRBCs often leads to death in less than 24 hours. Therapies include parental quinine or artesunate treatments. However, parasites have become resistant to these often pricey drugs thus limiting their effectiveness. Exchange Transfusion (ET) has been used as an adjunct treatment yet its efficacy remains the subject of clinical debate. mPharesis, a magnetic dialysis-like device, is in development to remove a patient's iRBCs without removing the healthy RBCs while minimizing plasma loss. The device, used in adjunct with drugs, provides a useful alternative to ET while being more accessible to low-resource settings where blood supply is limited. Here, preliminary data on a device prototype is reported. The device is made in-lab with inexpensive rapid manufacturing techniques. The magnetophoretic force is generated with an external permanent magnet array. Experiments were conducted *in vitro* using iRBCs and a non-pathogenic blood analog composed of a mixture of healthy and methemoglobin RBCs (metRBC) which has similar paramagnetic properties as iRBCs. Tests were conducted with multiple hematocrits and flow rates. The concentration of metRBC was reduced by as much as 24.7% for 15% Hct and 14.6% for 30% Hct in a single pass at a flow rate of 0.077 mL/min. Ongoing progress includes design modifications to allow for automation and increased throughput. In addition to malaria treatment applications, the mPharesis device could potentially be used as an alternative to ET with other disease management, such as sickle-cell disease.

Biography

Andrea Martin completed her Bachelor's of Science degree in Bionegineering with a minor in Mechanical Engineering from the University of Pittsburgh in 2012. She is currently a PhD candidate in Biomedical Engineering at Carnegie Mellon University.

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