Mock Flow Loop (MFL) For Self-Powered Fontan Circulation

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Abstract

The Fontan procedure is the current treatment for babies born with Hypoplastic Left Heart Syndrome (HLHS). The surgery entails multiple severe complications and a survival rate of less than 50% by adulthood. Modification to the Fontan surgery is proposed to lower mortality rate in patients. A bifurcating graft (IJS) has been designed and validated via computational fluid dynamics (CFD) to increase velocity and reduce pressure within the pulmonary arteries. A dynamically scaled mock flow loop (MFL) will be configured to validate the optimized IJS results obtained from the CFD design. The MFL will be based on a reduced Fontan lumped-parameter model (LPM) and will be comprised of RLC components of the systemic and the pulmonary circuit. These RLC values are obtained from clinical references to approximate normal human physiology specific to each vessel bed. The Harvard Medical pulsatile pump provides the targeted flow rate through the IJS. Flow and pressure sensor data at critical points in the MFL are acquired via National Instruments multichannel data acquisition board and processed using LabView. A patient-specific 3D model of the Fontan junction (test section) will be produced via 3D printing (inferior and superior vena cavae attached to left and right pulmonary arteries).