Characterization of an Arteriovenous Mock Circulation Loop for Testing Intervascular Bioartificial Organs J. Moyer[1], S. S. Sandhu[1], W. Fissell[2], S. Roy[3]

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Study: Mock circulation loops (MCL) have been described to replicate pulmonary and systemic arterial circulation for in vitro testing of ventricular assist devices. Development of hemofiltration-based implantable bioartificial organs (IBO), such as the intervascular bioartificial kidney and bioartificial pancreas, relies on peripheral arteriovenous (AV) interposition for implantation and function. We developed a MCL containing pulsatile systemic arterial and non-pulsatile venous systems to replicate in vivo AV flow and pressure conditions for in vitro testing of IBO prototypes.

Methods: An AV MCL was constructed consisting of a pneumatic ventricular pump, atrial chamber, aortic and mitral swing check valves, arterial compliance chamber, arterial resistor, venous collection chamber and venous roller pump. IBO prototypes were implanted in AV fashion in an adult Yucatan pig. Systemic arterial, inflow graft, and systemic venous pressures were recorded. IBO blood flow rate was assessed using bulk flow measurement. In vivo pressure and flow characteristics were then compared to in vitro data achieved in the MCL circulating 10% glycerol through IBO prototypes.

Results: In vivo arterial, graft and venous pressures were 110/69 (mean 86), 78/60 (72), and 13/6 (9), respectively. The MCL yielded arterial, graft, and venous pressures of 110/67 (mean 81), 79/48 (58), and 13/10 (11). IBO blood flow in vivo was 1032 mL/min, compared to 940 mL/min in the MCL. The MCL was successful in replicating in vivo AV pressure and flow conditions through IBO prototypes. Moreover, the MCL is portable, adjustable and reusable, allowing rapid iterative in vitro testing of IBO prototypes. This offers device feedback and refinement of IBO design prior to expensive in vivo trials