Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Venous valve dynamic behavior and function: a computational investigation MATTHEW BALLARD, PARKER ELLIOTT, Saint Martin's University — To fulfill their role of returning blood from the body back to the heart, veins often need pumping beyond that provided by the heart. This is especially true where blood must be raised vertically a significant distance against gravity, such as from the deep veins of the legs. Thus, many veins contain a series of "venous valves" which open and close with pressure fluctuations to allow flow only in the direction back toward the heart. These valves enable veins to act as a series of "miniature hearts" that provide the requisite pumping effect. Under certain conditions including flow stasis associated with sitting still, long airplane flights and surgery, venous valves can become blocked through thrombus formation (deep vein thrombosis, or DVT), causing insufficient blood flow. Thrombi can even break free and become lodged in the lungs as a deadly pulmonary embolism (PE). We use a three-dimensional, fully coupled fluid-solid model based on the lattice-Boltzmann and lattice spring models to investigate the behavior of a viscous fluid and venous valves in a section of vein. We study the dynamics of venous valves and assess the effect of valve morphology on fluid transport. Further, we study flow in the valve region with a focus on understanding its effect on development of disease. This work increases our understanding of venous valve behavior and the resulting flow conditions, with possible applications in evaluating patient risk for DVT and in designing prosthetic venous valves.

Matthew Ballard
Saint Martin's University

Date submitted: 31 Jul 2019 Electronic form version 1.4