Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Transitional Flow in an Arteriovenous Fistula: Effect of Wall Distensibility[1] PATRICK MCGAH, DANIEL LEOTTA, KIRK BEACH, ALBERTO ALISEDA, University of Washington — Arteriovenous fistulae are created surgically to provide adequate access for dialysis in patients with end-stage renal disease. Transitional flow and the subsequent pressure and shear stress fluctuations are thought to be causative in the fistula failure. Since 50% of fistulae require surgical intervention before year one, understanding the altered hemodynamic stresses is an important step toward improving clinical outcomes. We perform numerical simulations of a patient-specific model of a functioning fistula reconstructed from 3D ultrasound scans. Rigid wall simulations and fluid-structure interaction simulations using an in-house finite element solver for the wall deformations were performed and compared. In both the rigid and distensible wall cases, transitional flow is computed in fistula as evidenced by aperiodic high frequency velocity and pressure fluctuations. The spectrum of the fluctuations is much more narrow-banded in the distensible case, however, suggesting a partial stabilizing effect by the vessel elasticity. As a result, the distensible wall simulations predict shear stresses that are systematically 10-30% lower than the rigid cases. We propose a possible mechanism for stabilization involving the phase lag in the fluid work needed to deform the vessel wall.

[1]Support from an NIDDK R21 - DK08-1823

Patrick McGah
University of Washington

Date submitted: 03 Aug 2012

Electronic form version 1.4