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Elevated Shear Stress in Arteriovenous Fistulae: Is There Mechanical Homeostasis?[1] PATRICK MCGAH, DANIEL LEOTTA, KIRK BEACH, ALBERTO ALISEDA, University of Washington — Arteriovenous fistulae are created surgically to provide access for dialysis in patients with renal failure. The current hypothesis is that the rapid remodeling occurring after the fistula creation is in part a process to restore the mechanical stresses to some preferred level (i.e. mechanical homeostasis). Given that nearly 50% of fistulae require an intervention after one year, understanding the altered hemodynamic stress is important in improving clinical outcomes. We perform numerical simulations of four patient-specific models of functioning fistulae reconstructed from 3D Doppler ultrasound scans. Our results show that the vessels are subjected to 'normal' shear stresses away from the anastomosis; about 1 Pa in the veins and about 2.5 Pa in the arteries. However, simulations show that part of the anastomoses are consistently subjected to very high shear stress (>10Pa) over the cardiac cycle. These elevated values shear stresses are caused by the transitional flows at the anastomoses including flow separation and quasiperiodic vortex shedding. This suggests that the remodeling process lowers shear stress in the fistula but that it is limited as evidenced by the elevated shear at the anastomoses. This constant insult on the arterialized venous wall may explain the process of late fistula failure in which the dialysis access become occluded after years of use.

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Alberto Aliseda
University of Washington

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