

Brief Description of Research Project for Summer 2018

TITLE: Association of Bulk Blood Flow with Hemodialysis Arteriovenous Fistula Maturation

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RESEARCH PROJECT DESCRIPTION (brief overview of background, hypothesis, methods, role of medical student, funding and relevant publications -- SHOULD NOT EXCEED ~ 250 WORDS)

Arteriovenous fistula (AVF) is the preferred vascular access for maintenance hemodialysis; however, AVFs often fail to mature and hemodynamic factors may contribute to AVF maturation failure although the exact mechanism is still not known. Supported by NIH, we took MRI scans of about 60 patients to extract the fistula geometry and flow rates at 1 week, 6 weeks, and 6 months after fistula creation, then computational fluid dynamics (CFD) simulations were performed to approximate the fistula blood flow characteristics. Wall shear stress (WSS), which is the frictional force applied to the endothelial cells due to the velocity gradient near the vessel wall, has been extracted to examine the association of WSS with fistula remodeling and maturation. However, bulk flow may also play a significant role in fistula remodeling and is rarely investigated. We thus hypothesize that bulk flow is associated with fistula remodeling and maturation. Quantitative helicity-based parameters will be extracted from the already available CFD data files and the association of these parameters with fistula remodeling and maturation will be examined statistically by the medical student.

References:

1. He Y, Terry CM, Nguyen C, *et al.* Serial analysis of lumen geometry and hemodynamics in human arteriovenous fistula for hemodialysis using magnetic resonance imaging and computational fluid dynamics. *J Biomech.* 2013; 46.
2. Morbiducci U, Gallo D, Ponzini R, *et al.* Quantitative Analysis of Bulk Flow in Image-Based Hemodynamic Models of the Carotid Bifurcation: The Influence of Outflow Conditions as Test Case. *Annals of Biomedical Engineering.* 2010; 38: 3688-3705.