Near-Wall Vorticity as an Indicator of Marfan Syndrome

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Marfan syndrome (MFS) is a connective tissue disorder caused by mutations in the FBN1 gene. No efficient ways exist to screen for the inherited gene, so diagnosis of MFS is primarily clinical and relies on phenotypic data. Despite progress in MFS treatment, there remains a significant need for additional indicators of the disorder. Thus, this research project identifies a previously unknown connection between Marfan Syndrome and high levels of vorticity close to the aortic wall. It involves using computational fluid dynamics (CFD) to investigate vorticity throughout six aortas, three of which are healthy, and the other three of which have MFS and an aneurysm. Through the extraction of vortex cores, we find that the core lines lay closer to the center of the healthy aorta and closer to the wall of the Marfan aorta. To quantify our observations, we define a novel parameter of Near-Wall Vorticity Fraction (nwVF). After computing the nwVF for all six aortas, a paired t-test returns a p-value of 0.026, which is considered to be statistically significant. Therefore, nwVF can be used as a tool to diagnose MFS in cases that escape conventional phenotypic analysis.

Awards Won:
Third Award of $1,000