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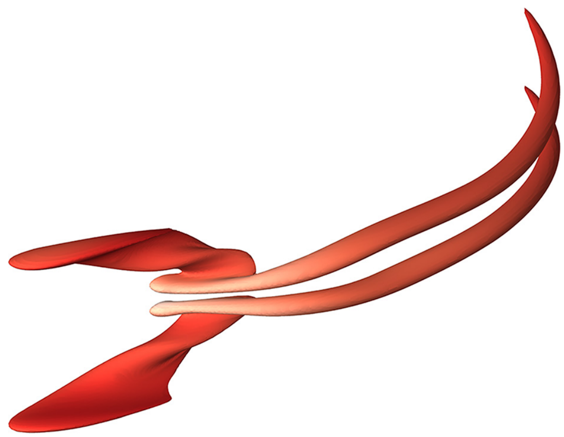
A computer simulation shows how vortices moving through a curved artery may correlate with heart disease.



In a curved artery, such as the aortic arch, vortices can be produced from spiraling blood flow. These vortices may abnormally alter shear stress on the arterial wall which can lead to cardiovascular diseases and potential aneurysms.

To better understand the progression of disease in arteries, Cox et al. investigated the impact of the temporal and spatial evolution of vortices in blood flow and their effects on shear stress on artery walls.

“Under a given physiological flow condition and arterial geometric curvature, we can have a better idea about what types of blood flow patterns may play a role in cardiovascular disease,” said author Christopher Cox.

To study physiological flow conditions of vortices through a curved artery, the authors performed numerical simulations of a simple 180-degree curved pipe with a circular cross-section and constant curvature. They validated their numerical results with experimental results obtained using particle image velocimetry. The authors were able to identify three-dimensional swirling flow patterns through the curved artery.

“We concluded that the combination of intense rotating flow and reverse flow near the inner wall of the curve leads to local abnormalities in the shear stress – a potentially significant result since cardiovascular disease is known to progress along the inner wall of actual curved arteries in the human body,” said Cox.

The results of this research also have applications in industry, as vortices in water or other fluids can exist in all types of curved pipes and alter the flows within.

Source: “Three-dimensional vortical structures and wall shear stress in a curved artery model,” by Christopher Cox, Mohammad Reza Najjari, and Michael W. Plesniak, *Physics of Fluids* (2019). The article can be accessed at https://doi.org/10.1063/1.5124876.