Towards Predictive Simulation of Artificial Blood Pumps

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ABSTRACT

Modeling and computational analysis play an increasingly important role in bioengineering, particularly in the design of implantable ventricular assist devices (VAD) and other blood-handling devices. Numerical simulation of blood flow and associated physiological phenomena has the potential to shorten the design cycle and give the designers important insights into causes of blood damage and suboptimal performance. A set of modeling techniques is presented which are based on stabilized space-time finite element formulation of the Navier-Stokes equations. Alternate methods that represent the rotating components in an averaged sense using a rotating frame of reference will be discussed [1]. In order to obtain quantitative hemolysis prediction, cumulative tensor-based measures of strain experienced by individual blood cells must be developed; red blood cells under shear can be modeled as deforming droplets, and their deformation tracked throughout the flow volume [2]. The methods are applied to a simplified rotary blood pump, which is currently a subject of an inter-laboratory round-robin study.

REFERENCES

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[2] L. Gesenhues, L. Pauli and M. Behr, Strain-Based Blood Damage Estimation for Computational Design of Ventricular Assist Devices, *International Journal of Artificial Organs*, (2016) **39**:166–170.