www.elsevier.com/locate/jbiomech

Inertial Particle Dynamics in Large Artery Flows - Implications for Modeling Arterial Embolisms

Debanjan Mukherjee, Shawn C. Shadden

PII: S0021-9290(16)31321-5
DOI: http://dx.doi.org/10.1016/j.jbiomech.2016.12.028
Reference: BM8061

To appear in: *Journal of Biomechanics*

Accepted date: 21 December 2016

Inertial Particle Dynamics in Large Artery Flows - Implications for Modeling Arterial Embolisms

Debanjan Mukherjee *[1] and Shawn C. Shadden †[1]

[1]Dept. of Mechanical Engineering, University of California, Berkeley

draft manuscript for submission

Abstract

The complexity of inertial particle dynamics through swirling chaotic flow structures characteristic of pulsatile large-artery hemodynamics renders significant challenges in predictive understanding of transport of such particles. This is specifically crucial for arterial embolisms, where knowledge of embolus transport to major vascular beds helps in disease diagnosis and surgical planning. Using a computational framework built upon image-based CFD and discrete particle dynamics modeling, a multi-parameter sampling-based study was conducted on embolic particle dynamics and transport. The results highlighted the strong influence of material properties, embolus size, release instance, and embolus source on embolus distribution to the cerebral, renal and mesenteric, and ilio-femoral vasculature beds. The study also isolated the importance of shear-gradient lift, and elastohydrodynamic contact, in affecting embolic particle transport. Near-wall particle re-suspension due to lift alters aortogenic embolic particle dynamics significantly as compared to cardiogenic. The observations collectively indicated the complex interplay of particle inertia, fluid-particle density ratio, and wall collisions, with chaotic flow structures, which render the overall motion of the particles to be non-trivially dispersive in nature.

Keywords: *hemodynamics, fluid-particle interaction, embolism, elastohydrodynamic lubrication, shear-gradient lift*

*debanjan@berkeley.edu

†shadden@berkeley.edu