Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Vortex Imprints at the Wall, But Not in the Bulk, Distinguish Ruptured from Unruptured Intracranial Aneurysms[1] NICOLE VARBLE, HUI MENG, University at Buffalo, The State University of New York — Intracranial aneurysms affect 3% of the population. Risk stratification of aneurysms is important, as rupture often leads to death or permanent disability. Image-based CFD analyses of patient-specific aneurysms have identified low and oscillatory wall shear stress to predict rupture. These stresses are sensed biologically at the luminal wall, but the flow dynamics related to aneurysm rupture requires further understanding. We have conducted two studies: one examines vortex dynamics, and the other, high frequency flow fluctuations in patient-specific aneurysms. In the first study, based on Q-criterion vortex identification, we developed two measures to quantify regions within the aneurysm where rotational flow is dominate: the ratio of volume or surface area where Q >0 vs. the *total* aneurysmal volume or surface area, respectively termed volume vortex fraction (VVF) and surface vortex fraction (SVF). Statistical analysis of 204 aneurysms shows that SVF, but not VVF, distinguishes ruptured from unruptured aneurysms, suggesting that once again, the local flow patterns on the wall is directly relevant to rupture. In the second study, high-resolution CFD (high spatial and temporal resolutions and second-order discretization schemes) on 56 middle cerebral artery aneurysms shows the presence of temporal fluctuations in 8 aneurysms, but such flow instability bears no correlation with rupture.

[1]Support for this work was partially provided by NIH grant (R01 NS091075-01) and a grant from Toshiba Medical Systems Corp.

Hui Meng
University at Buffalo, The State University of New York

Date submitted: 03 Aug 2015 Electronic form version 1.4