AbstractID: 1533 Title: Analytical description of flow in cerebral aneurysms using optical velocimetry data for development of interventional devices

Aneurysms are deformations of the artery wall which occur in regions subject to high mechanical flow induced stress. For treatment of these deformations, devices may be deployed under fluoroscopic guidance so as to modify flow and induce thrombosis. New devices designed for treatment of aneurysms are first verified in phantoms using various flow evaluation techniques. One new treatment we designed consists of bypassing the aneurysm neck using a unique asymmetric stent. We propose a new analytical method to evaluate flow in pre- and post- stented aneurysms. The method is based on fitting data obtained from optical flow studies in an aneurysm phantom using Particle Image Velocimetry (PIV). In PIV, the flow of fluorescent particles is illuminated in the target area with a pulsed-laser light-sheet and images are acquired using a CCD camera. By registering the position of the particles in two successive images the velocity vector components are accurately calculated for a matrix of locations in a single plane. We found that the best fit to describe analytically these vector fields inside the aneurysm are cosine bivariate polynomial series. The fit agreed with the data, $R^2=0.93$. Our method also enables use of flow velocity components in the plane of acquisition for evaluation of other important quantities such as wall shear stress, vorticity, and inflow into the aneurysm. Thus the analytical fitting method facilitates device design optimization by relating flow quantities to device parameters. (Partially supported by NIH Grant 1R01EB002873, Toshiba Corp and Guidant Corp.)