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Hemodynamic Intervention of Cerebral Aneurysms HUI MENG, University at Buffalo and Toshiba Stroke Research Center — Cerebral aneurysm is a pathological vascular response to hemodynamic stimuli. Endovascular treatment of cerebral aneurysms essentially alters the blood flow to stop them from continued growth and eventual rupture. Compared to surgical clipping, endovascular methods are minimally invasive and hence rapidly gaining popularity. However, they are not always effective with risks of aneurysm regrowth and various complications. We aim at developing a Virtual Intervention (VI) platform that allows: patient-specific flow calculation and risk prediction as well as recommendation of tailored intervention based on quantitative analysis. This is a lofty goal requiring advancement in three areas of research: (1). Advancement of image-based CFD; (2) Understanding the biological/pathological responses of tissue to hemodynamic factors in the context of cerebral aneurysms; and (3) Capability of designing and testing patient-specific endovascular devices. We have established CFD methodologies based on anatomical geometry obtained from 3D angiographic or CT images. To study the effect of hemodynamics on aneurysm development, we have created a canine model of a vascular bifurcation anastomosis to provide the hemodynamic environment similar to those in CA. Vascular remodeling was studied using histology and compared against the flow fields obtained from CFD. It was found that an intimal pad, similar to those frequently seen clinically, developed at the flow impingement site, bordering with an area of 'groove' characteristic of an early stage of aneurysm, where the micro environment exhibits an elevated wall shear stresses. To further address the molecular mechanisms of the flow-mediated aneurysm pathology, we are also developing in vitro cell culture systems to complement the in vivo study. Our current effort in endovascular device development focuses on novel stents that alters the aneurysmal flow to promote thrombotic occlusion as well as favorable remodeling. Realization of an effective VI platform requires a strong multi-disciplinary team of engineers, biologists and clinicians.

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