Hemodynamic Forces in the Progression of Intracranial Aneurysms

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Hemodynamic forces are thought to be important in driving changes in aneurysm morphology over time. We studied 78 patients with 88 untreated aneurysms of the intracranial circulation with serial MR imaging. Of these, 15% showed volume increases over time. Computational Fluid Dynamics calculations were performed using geometric and inlet flow boundary conditions as determined from in vivo MRI. Wall shear stress was computed over the surface of each aneurysm in subjects where the aneurysm was found to grow, and in matched subjects whose aneurysm remained stable over time. Aneurysms that grew were found to have a substantially larger fraction of their surface area exposed to low wall shear stress than aneurysms that remained stable over time. Furthermore, regions of observed growth were found to co-locate with regions of low wall shear stress. Patient-specific modeling can help assess which patients need immediate intervention and which can be followed with watchful waiting.

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