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In vivo and in vitro measurements of cerebral aneurysm hemodynamics OMID AMILI, MOSTAFA TOLOUI, PIERRE-FRANCOIS VAN DE MOORTELE, BHARATHI JAGADEESAN, FILIPPO COLETTI, University of Minnesota Twin Cities — The hemodynamics of cerebral aneurysms is thought to play a critical role in their formation, growth, and potential rupture. Our understanding in this area, however, comes mostly from in vitro experiments and numerical simulations, which have limited realism. In vivo measurements of the intracranial blood flow can be obtained by Magnetic Resonance Imaging (MRI), but they typically suffer from limited accuracy and inadequate resolution. Here we present a direct comparison between in vivo and in vitro measurements of the flow inside an internal carotid artery aneurysm. For both, we use 4D (i.e. volumetric and time-resolved) MRI velocimetry performed in a 7 Tesla magnet at sub-millimeter resolution. The in vitro measurements are carried out in a 3D printed aneurysm replica scaled up by a factor three, effectively increasing the spatial resolution. The patient-specific inflow waveform and the corresponding Reynolds and Womersley numbers are matched in a flow loop that mimics the impedance of the vascular bed. Direct comparison of the velocity fields allows assessing the robustness of the in vivo measurements, while highlighting the insight achievable in vitro. The data also represents a comprehensive test case for numerical simulations.

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