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Abstract

Although microfluidic systems have been important tools in analytical chemistry, life sciences, and medical research, their application was rather limited for drug-screening and biosensors. Here, we described a microfluidic device consisting of a multilayer micro-channel system that represented the hemodynamic cerebral vascular system. We analyzed wall shear stresses related to aneurysm formation in the circle of Willis (CoW) and their morphological variations using this system. This device was controlled by pneumatic valves, which occluded various major arteries by closing the associated channels. The hemodynamic analysis indicated that higher degrees of shear stress occurred in an anterior communicating artery (ACoA), particularly in the hypoplastic region of the posterior communicating artery (PCoA) and the P1 segment. Furthermore, occlusion of a common carotid artery (CCA) or a