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Microfluidic strategy to investigate dynamics of small blood vessel function SANJESH YASOTHARAN, STEFFEN-SEBASTIAN BOLZ, AXEL GUENTHER, University of Toronto — Resistance arteries (RAs, 30-300 microns in diameter) that are located within the terminal part of the vascular tree regulate the laminar perfusion of tissue with blood, via the peripheral vascular resistance, and hence controls the systemic blood pressure. The structure of RAs is adapted to actively controlling flow resistance by dynamically changing their diameter, which is non-linearly dependent on the temporal variation of the transmural pressure, perfusion flow rate and spatiotemporal changes in the chemical environment. Increases in systemic blood pressure (hypertension) resulting from pathologic changes in the RA response represent the primary risk factor for cardiovascular diseases. We use a microfluidic strategy to investigate small blood vessels by quantifying structural variations within the arterial wall, RA outer contour and diameter over time. First, we document the artery response to vasomotor drugs that were homogeneously applied at step-wise increasing concentration. Second, we investigate the response in the presence of well-defined axial and circumferential heterogeneities. Artery per- and superfusion is discussed based on microscale PIV measurements of the fluid velocity on both sides of the arterial wall. Structural changes in the arterial wall are quantified using cross-correlation and proper orthogonal decomposition analyses of bright-field micrographs.

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