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FLUID FLOW OF BIOMIMETIC FLUIDS IN COMPLEX MICROCHANNELS FOR MICROCIRCULATION STUDIES

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Summary: Biomicrofluidics addresses as a common practice to use in vitro blood to investigate blood flow phenomena observed in real microvessels, However, this approach is not straightforward, as handling with real blood brings numerous difficulties related to sanitary, bureaucratic and technical problems. In this context, the use of biomimetic fluids flowing in microchannels has been explored within the last years, but in most studies, researchers still struggle with the properties of the blood analogues, particularly when mimicking red blood cells mechanical properties and flow behaviour. In this context, and following our previous work, the present study explores the use of a simple, stable and low cost 2-phase blood analogue fluid, which can mimic multiphase phenomena of real flow in microcirculation. The analogue fluid is compared with real blood, regarding its physical properties and the flow behaviour for complex PDMS - Polydimethylsiloxan microchannels, made using soft lithography. The microchannels geometry addresses bifurcations. The results on the particle size distribution confirm the reproducibility of the fluid preparation, as well as of its stability. The analogue fluid density is close to that of water, thus approaching the blood density. Furthermore, the blood analogue fluid depicts a shear thinning behaviour, matching that of blood, except for very high concentrations of surfactant. Fluid flow experiments show that the blood analogue can generate cell-free layers (CFL), with thickness close to that of real blood. Increasing the surfactant concentration promotes the augmentation of the CFL's, but also endorses agglomeration and clogging. Flow separation occurs also at the highest surfactant concentrations, which makes more difficult for the particles to follow the flow, so that flow field evaluation becomes more difficult.