Mixing in blood flow

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Abstract

Mixing is crucial in blood flow since blood is known to transport oxygen by red blood cells (RBC) and essential macromolecules by the plasma, its liquid suspending phase. Macromolecules and other moieties are constantly exchanged between blood and the vessel walls. A good mixing is therefore essential for the organism. In parallel, during the past few decades, synthetic micro- and nanoparticles have also been transported by the blood stream used as drug, gene and/or imaging delivery vehicles [1]. Mixing and availability near the vessels walls in these cases are prerequisites to their function. In recent years, bacteria-assisted tumor-targeted therapy has been proposed to be used as models for drug-, therapeutic- or gene blood delivery vehicles with great promise in the treatment of cancer.

We propose in this work to discuss the importance of blood being a concentrated suspension of RBC in the mixing process that happens every day in the body at the microcirculatory site. By the use of squared-cross-sectional microchannels, we investigate the mixing of fluorescent macromolecules in a suspension of RBC of different volume fractions and flow rates around the physiological value. We show that mixing process of macromolecules depends not only on the volume fraction of RBC but also strongly on the flow rate. Mixing improves for higher flow rates for fix RBC volume fraction values. Besides, an optimum RBC volume fraction has been found to maximize the mixing process. Our results shown that RBCs are not only essential bodies for the transport of oxygen but are also fundamental entities acting directly on the improvement of macromolecule mixing present on their liquid suspending phase. We also discuss possible mechanisms of bacteria diffusion under the same conditions. Finally, we proposed our system as a model for other problems associated to microfluidics applications, where the mixing process is essential.

References

[1]Müller K., Fedosov D. and Gompper G. *Margination of micro- and nano-particles in blood flow and its effect on drug delivery*. Scientific Reports (**4)**, 4871 (2014)