Intricate journey of micro- and nano-carriers for drug delivery in the blood stream

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ABSTRACT

Drug delivery by various micro- and nano-carriers offers the possibility of controlled transport of pharmaceuticals to targeted sites (e.g., cancerous tissue). The adhesion of micro- and nano-carriers in blood flow is strongly affected by their distribution within the vessel cross-section. To investigate the adhesion potential of carriers of different sizes, we employ mesoscopic hydrodynamic simulations of blood flow in order to predict margination of carriers or their migration properties toward vessel walls. The margination of carriers is studied for a wide range of hematocrit values and flow rates, and various sizes, ranging from about hundred nanometers to several micrometers, are considered [1]. Our results show that margination strongly depends on the thickness of the available free space close to the wall, the so-called red blood cell-free layer (RBC-FL), in comparison to the carrier size [2]. The carriers with a few micrometers in size are comparable with the RBC-FL thickness and marginate better than their sub-micrometer counterparts. Deformable carriers, in general, show worse margination properties than rigid particles. Particle margination is also found to be most pronounced in small channels with a characteristic size comparable to blood capillaries. As a conclusion, micron-size particles seem to be favorable for vascular drug delivery in comparison to sub-micron carriers.

REFERENCES

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