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An acoustically-driven biochip - Impact of flow on the cell-association of targeted drug carriers

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The interaction of targeted drug carriers with epithelial and endothelial barriers in vivo is largely determined by the dynamics of the body fluids. To simulate these conditions in binding assays, a fully biocompatible in vitro model was developed which can accurately mimic a wide range of physiological flow conditions on a thumbnail-format cell-chip. This acoustically-driven microfluidic system was used to study the interaction characteristics of protein-coated particles with cells. Poly(D,L-lactide-co-glycolide) (PLGA) microparticles (2.86 {\pm} 0.95 {\mu}m) were conjugated with wheat germ agglutinin (WGA-MP, cytoadhesive protein) or bovine serum albumin (BSA-MP, nonspecific protein) and their binding to epithelial cell monolayers was investigated under stationary and flow conditions. While mean numbers of 1500 {\pm} 307 mm-2 WGA-MP and 94 {\pm} 64 mm-2 BSA-MP respectively were detected to be cell-bound in the stationary setup, incubation at increasing flow velocities increasingly antagonized the attachment of both types of surface-modified particles. However, while binding of BSA-MP was totally inhibited by flow, grafting with WGA resulted in a pronounced anchoring effect. This was indicated by a mean number of 747 {\pm} 241 mm-2 and 104 {\pm} 44 mm-2 attached particles at shear rates of 0.2 s-1 and 1 s-1 respectively. Due to the compactness of the fluidic chip which favours parallelization, this setup represents a highly promising approach towards a screening platform for the performance of drug delivery vehicles under physiological flow conditions. In this regard, the flow-chip is expected to provide substantial information for the successful design and development of targeted micro- and nanoparticulate drug carrier systems.

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