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An Acoustically-Driven Biochip: Particle-Cell Interactions Under Physiological Flow Conditions

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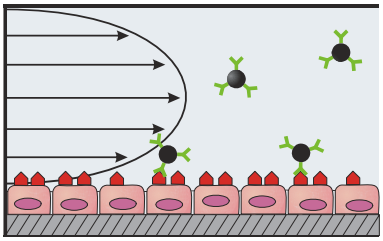
Introduction: The interaction of particulate drug carriers with cells has generally been assessed in stationary microplate assays. These setups fail to reflect the flow conditions in vivo which generate substantial hydrodynamic drag forces [1]. In order to address this shortcoming, a microfluidic biochip with the capability of imitating a wide range of shear rates and pulsation modes has been developed. This device, which is based on an incorporated surface acoustic wave pump, was used to study the interaction of targeted microparticles with epithelial cells under flow conditions.



Materials and Methods: Microparticles were produced from poly(D,L-lactide-*co*-glycolide) by a spray drying technique [2]. These colloids were surface modified with a carbohydrate-binding protein (wheat germ agglutinin, WGA-MP, cytoadhesive ligand) or bovine serum albumin (BSA-MP, non-specific ligand). Upon addition of the particle suspension ($1.5*10^6$ ml^{-1}) to Caco-2 monolayers grown in 3D-microchannels on the flow-chip, the channels were subjected to incubation under stationary or flow conditions (shear rates ranging from 0.2 s^{-1} to 1 s^{-1}) for 30 min.

Results and Discussion: Under stationary conditions 1553 ± 227 mm^{-2} WGA-MP and 151 ± 47 mm^{-2} BSA-MP respectively were monitored as cell-bound. Obviously, surface modification with WGA mediated adhesion of the particles to the Caco-2 monolayer via the binding to sugar residues of the cells' glycocalyx. When incubated under flow conditions, cytoadhesion of the microparticles decreased with increasing flow velocities. The generally low cytoadhesion of BSA-conjugated microparticles was almost completely inhibited by flow, while an anchoring effect was observed in the case of surface modification with WGA. In conclusion, the presented microfluidic system is a valuable tool for the simulation of in vivo conditions. This will aid in the development of advanced drug carrier systems which efficiently attach to the target tissue in vivo.

[1] Florence AT. *Nanoparticle flow: Implications for drug delivery.* In: Nanoparticles as drug carriers (Ed.: V. P. Torchilin), Imperial College Press, London, 2006: 9–27.

[2] Ertl B, Heigl F, Wirth M, Gabor F. Lectin-mediated bioadhesion: preparation, stability and caco-2 binding of wheat germ agglutinin-functionalized Poly(D,L-lactic-co-glycolic acid)-microspheres. J. Drug Targ. 2000; 8: 173–184. doi:10.3109/10611860008996863

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