Engineered Lego®-like microphysiological models of the human airway clearance phenomena

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Abstract

Mucociliary clearance is a crucial event that supports the elimination of inhaled particles, bacteria, pollution and hazardous agents from the human airways, and it also limits the diffusion of aerosolized drugs into the airway epithelium. In spite of its relevance, few in vitro models sufficiently address the cumulative effect of the steric and interactive barrier function of mucus on the one hand, and the dynamic mucus transport imposed by ciliary mucus propulsion on the other hand. Here, ad hoc mucus models of physiological and pathological mucus are combined with magnetic artificial cilia to model mucociliary transport in both physiological and pathological states. The Lego®-like concept adopted, in this study, enables the development of mucociliary clearance models with high versatility, since these can be easily modified to reproduce phenomena characteristic of healthy and diseased human airways, while allowing to determine the effect of each parameter and/or structure separately on the overall mucociliary transport. These Lego®-like airway models can be available off-the-shelf because they are exclusively made of readily available materials, thus ensuring reproducibility across different laboratories.

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