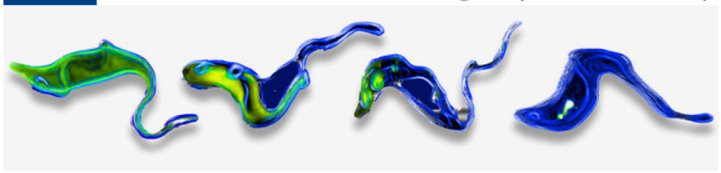

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Motile cilia induce Periciliary transport.

The ciliated epithelium of the human respiratory tract is lined by a thin stratified fluid. The airway surface liquid (ASL) serves as a protective barrier and is essential for maintaining normal respiratory mechanics. However, our understanding on how it is propelled by cilia and how flow is coupled between the two ASL compartments is still fragmentary. Mucus transport can be measured experimentally via various techniques, but the complex and impenetrable structure of the Periciliary Layer (PCL), occupied by cilia-tethered mucins which create a brush with nanometric mesh size, is more challenging as for example it interferes with the conventional use of tracer beads. Earlier studies have measured the average displacement of fluorescent dyes localised in the PCL, but have not managed to extract a clear velocity profile in this layer. In the last decades, great effort has also been put in understanding cilia-driven flows from a theoretical perspective. However, given the complexity of the system, many studies simulated the problem by introducing one or several approximations, commonly producing contrasting results.
We tackled the constrains posed by the PCL structure with the use of caged-fluorescent compound and high-speed imaging of airway epithelium from a side view. Briefly, we photoactivated the dye in a micrometric region within the PCL and followed its translation over time along lines parallel to the epithelium. The compound is activated at different distances from the cell apical surface to measure the transport as a function of the position within the PCL. Our findings show that the dye displacement is generally segmented, suggesting that the compound is transported with two prominent speeds for short (< 1 s) and long-times. The two speeds appear almost constant along the cilium length, with the first one being almost four time bigger than the second one. Moreover, we found that decreasing the temperature from 37℃ to room temperature reduces PCL transport and has its major effects on the short-time speed.

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