Insights: Publications

In Vivo Imaging of Airway Cilia and Mucus Clearance with Micro-Optical Coherence Tomography

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We have designed and fabricated a 4 mm diameter rigid endoscopic probe to obtain high resolution micro-optical coherence tomography (µOCT) images from the tracheal epithelium of living swine. Our common-path fiber-optic probe used gradient-index focusing optics, a selectively coated prism reflector to implement a circular-obscuration apodization for depth-of-focus enhancement, and a common-path reference arm and an ultra-broadbrand supercontinuum laser to achieve high axial resolution. Benchtop characterization demonstrated lateral and axial resolutions of 3.4 µm and 1.7 µm, respectively (in tissue). Mechanical standoff rails flanking the imaging window allowed the epithelial surface to be maintained in focus without disrupting mucus flow. During in vivo imaging, relative motion was mitigated by inflating an airway balloon to hold the standoff rails on the epithelium. Software implemented image stabilization was also implemented during post-processing. The resulting image sequences yielded co-registered quantitative outputs of airway surface liquid and periciliary liquid layer thicknesses, ciliary beat frequency, and mucociliary transport rate, metrics that directly indicate airway epithelial function that have dominated in vitro research in diseases such as cystic fibrosis, but have not been available in vivo.

Related People



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