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A platform for measuring mucus rheology and cilia activity without sample disruption

Stanford scientists have developed a method and apparatus for simultaneously measuring mucus rheology and cilia activity on live airway cells without removing mucus or inhibiting cilia function. This platform can accelerate drug and therapy development for muco-obstructive lung diseases such as cystic fibrosis, asthma, and pulmonary ciliary dyskinesia.

Mucus and cilia in the airways act as the body's first line of defense against pathogens. Mucus serves as a barrier to capture pathogens before they reach epithelial tissue, while cilia propel the mucus to clear captured pathogens from the airway. Disturbances to mucus rheology or cilia activity can substantially impair lung function, as seen in muco-obstructive lung diseases such as cystic fibrosis, asthma, and pulmonary ciliary dyskinesia. Current methods for measuring mucus rheology require either removing mucus from cultured cells or inhibiting cilia activity, and measuring cilia function similarly requires mucus removal. These limitations make it difficult to study the interplay between mucus and cilia under physiologically relevant conditions, hindering drug and therapy development for these diseases.

This platform uses a magnetically-driven probe and optical microscopy to measure mucus rheology and cilia activity simultaneously on live cell cultures. Unlike existing methods that require removing mucus or inhibiting cilia function, this approach preserves the native environment of the cells, allowing researchers to study mucus and cilia interactions under physiologically relevant conditions. This capability could enable more accurate screening of drug candidates targeting muco-obstructive lung diseases and reduce the time and complexity of preclinical research workflows.

Stage of Development:
Research – *in-vitro*

Continued research - The device is being refined to enhance sensitivity and expand its range of operation. The platform is also being used to study mucus rheology, cilia activity, and their interactions on airway epithelial cell cultures to advance understanding of airway disease and potential treatments.

Applications

- Measurement of mucus rheology and cilia activity for muco-obstructive lung disease research
- Drug and therapy screening for cystic fibrosis, asthma, and pulmonary ciliary dyskinesia
- Study of mucociliary interactions under physiologically relevant conditions

Advantages

- Simultaneous measurement of mucus rheology and cilia activity without sample disruption
- Preserves native cell environment by eliminating the need to remove mucus or inhibit cilia function
- Enables direct study of mucus and cilia interactions on live cell cultures

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