**Introduction**

Infant Respiratory distress syndrome (IRDS) represents a leading cause of neonatal death and disability [Rodriguez, 2003], owing to respiratory failure as a result of deficiencies in pulmonary surfactant secretion by type II alveolar epithelial cells (AECs). Proper production of pulmonary surfactant indicates maturity of the developing lung and is linked to mechanical distensions experienced by AECs [Wirtz et al, 1990]. During prenatal life, mechanical forces arise from fetal breathing movements (FBMs) in the liquid-filled lungs [Harding and Hooper, 1996]. Distensions and rhythmic liquid displacement caused by expansion and contraction motions translate into stresses and strains applied on AECs. Although the role of mechanical distensions (i.e. strains) on the development and maturation of AECs is well established [Arold et al, 2008], the role of fluid shear stress for surfactant production still remains poorly understood.

Using immunocytochemistry (ICC), cells are examined for the presence of the most abundant surfactant protein (SP-A) in the lungs. We detect the regulated secretion of surfactant through exocytosis of secretory vesicles, i.e. lamellar bodies (LBs), and their fusion with the plasma membrane. We also examine the influence of shear stress on the actin cytoskeleton arrangement within AECs.

**Methods**

To study the influence of fluid shear stress stimulation on AEC surfactant production, we have developed a simple in-vitro microfluidic model of small airways of the fetal lung. Human type II AECs (A549) are cultured in microchannels reproducing one-to-one length scale features of prenatal pulmonary airways (Fig. 1). Cells are maintained under constant perfusion of growth media to mimic liquid displacements (FBMs) resulting in shear stresses applied on the epithelium monolayer. Namely, we investigate the influence of shear stress ($\tau$) magnitude, duration and cyclicity.

**Results & Discussion**

Initial findings suggest that surfactant production of type II AECs is sensitive to fluid shear stress (Fig. 2a). Concurrently, this process is accompanied with shear stress-mediated transport of LBs towards the cortical region of AECs (Fig. 2b). However, fusion events that feature LB exocytosis are found to remain constant for shear stress magnitudes <8 dyn/cm². At higher values, disorganization of actin filaments is observed to be a causal factor that precedes LB exocytosis.

Overall, our microenvironments provide a platform to unveil the effects of fluid shear stress on type II AEC surfactant production at the physiological scale. These efforts represent an important stepping stone towards uncovering the coupling between FBMs in the liquid-filled fetal lung and severity of RDS in preterm neonate.

**References**


