PhD in Chemical Sciences
Department of Chemistry "Ugo Schiff"
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PhD Seminar

Molecular Mechanisms to maintain an operative (and accessible) respiratory surface in health and disease

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Abstract

In order to maintain the large respiratory surface of mammalian alveoli exposed to air, lung pneumocytes synthetize and secrete an elaborated lipid-protein complex, pulmonary surfactant, in charge of reducing surface tension at the thin aqueous layer coating the epithelium. This complex also integrates elements in charge of establishing an innate barrier against the entrance of the many pathogens and noxious components and particles contained within the thousands of litters of air breathed every day.

The pulmonary surfactant system has evolved to simultaneously optimize apparently contradictory properties. It has a highly dynamic character, crucial to rapidly adsorb at the air-liquid interface and to spread along the continuous compression-expansion breathing cycling. However, at the same time, surfactant films must sustain maximal mechanical stability to sustain very high lateral pressures at the end of exhalation, without collapsing. To sustain this unique behavior, surfactant depends on the crucial action of very small, extremely hydrophobic proteins. Lack or alteration of surfactant proteins or of their protein-lipid and protein-protein interactions has been associated with severe acute and chronic respiratory pathologies.

The lecture will summarize current integrated models on how surfactant proteins sustain and modulate breathing dynamics and how this can be altered as a consequence of lung injury. In particular the lecture will give examples on how to generate in vitro models to mimic the respiratory air-liquid interface under breathing-like dynamics, and how these models can be used to optimize novel surfactant-based therapies.