FriSBi

Liquid plug formation in human airways

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The airway of human lungs articulate from the windpipe in a network of bifurcating branches known asbronchi and bronchioles. At each airway generation, i.e. when a branch bifurcates, the airway cross sectionreduces, up to becoming microscopic when it connects to the alveoli. Considering that human lung airwayis coated lined with a liquid made out of mucus and serous, after 8 or 9 generations the surface tensionbetween this liquid layer and the air might induce a Rayleigh-Plateau instability of a thick-enough liquidfilm. This phenomenon, known as airway closure, creates a liquid plug which blocks the airway haltingdistal gas exchange. Consequence of the airway closure are the flow-induced high stress levels on the wall,which is the location of airway epithelial cells. Relevant conditions for human lungs are simulated, takinginto account ordinary and pathological parameters. Our numerical prediction is able to capture the physicalprocess from pre- to post-coalescence, whereas previous studies have been limited to pre-coalescence only.Therefore, we can study the effect of the topological change, and we discovered that during coalescence, ahigh level of stress and stress gradients is exerted on the epithelial cells. We find that wall stresses during thepost-coalescence phase can be in the range of 300% to 600% greater than pre-coalescence values. Hence,airway closure qualifies as a cause of sub-lethal or lethal responses for the epithelial cells.

Friday, September 14, 2018 03:00pm - 04:00pm

Mondi Seminar Room 3, Central Building

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