

Abstract Submitted
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Clearance of a Mucus Plug¹ SHIYAO BIAN, YING ZHENG, JAMES B. GROTBORG, University of Michigan, Ann Arbor — Mucus plugging may occur in pulmonary airways in asthma, chronic obstructive pulmonary disease (COPD) and cystic fibrosis. How to clear the mucus plug is essential and of fundamental importance. Mucus is known to have a yield stress and a mucus plug behaves like a solid plug when the applied stresses are below its yield stress τ_y . When the local stresses reaches τ_y , the plug starts to move and can be cleared out of the lung. It is then of great importance to examine how the mucus plug deforms and what is the minimum pressure required to initiate its movement. The present study used the finite element method (FEM) to study the stress distribution and deformation of a solid mucus plug under different pressure loads using ANSYS software. The maximum shear stress is found to occur near the rear transition region of the plug, which can lead to local yielding and flow. The critical pressure increases linearly with the plug length and asymptotes when the plug length is larger than the half channel width. Experimentally a mucus simulant is used to study the process of plug deformation and critical pressure difference required for the plug to propagate. Consistently, the fracture is observed to start at the rear transition region where the plug core connects the films. However, the critical pressure is observed to be dependent on not only the plug length but also the interfacial shape.

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