Chronic Obstructive Pulmonary Disease (COPD) is a progressive disease that gradually destroys the normal structure of the lung resulting in airspace enlargement and subsequent loss of lung function including tissue elasticity and gas exchange. Currently, the mechanisms driving the progression of COPD is not fully understood and there is no cure. In this presentation, I will review several studies from our laboratory, which provide experimental evidence that mechanical forces in the lung play a critical role in COPD; namely, the enzymatically weakened tissue under mechanical forces ruptures which redistributes the load around the rupture site increasing the risk of further rupture. This represents a positive feedback mechanism that can explain the progressive nature of COPD. Incorporating these ideas in a network model provides results that are consistent with lung structure on histologic images at the microscale as well as clinically measurable CT images of COPD patients at the macroscale. We have also developed a novel personalized computational network model that allows spatiotemporal simulations of mechanical stresses and hence predicting the location of tissue deterioration. Our approach may find implications for predicting the personalized rate of decline of lung structure and function in response to interventions such as drug treatment or lung volume reduction.

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