Study of lung function sheds light on ventilator-induced lung injuries in elderly patients

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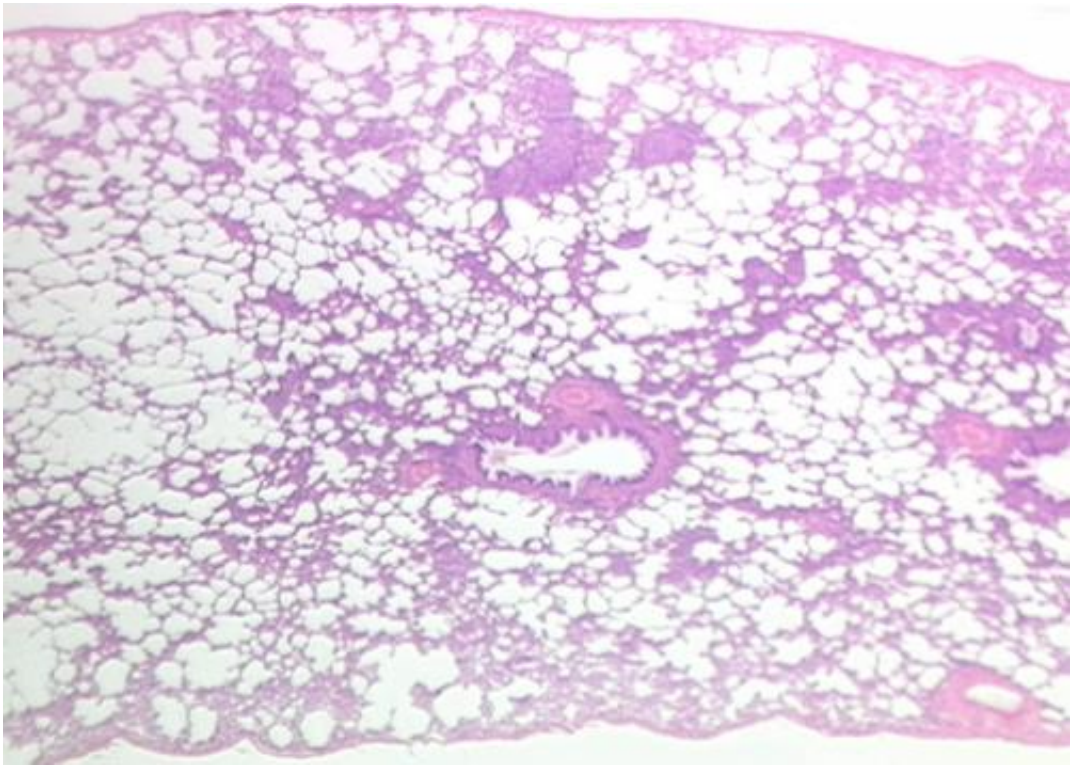

Lung tissue. Credit: Rutgers University

Mechanical ventilation can be a lifesaver for patients suffering from lung disorders such as chronic obstructive pulmonary disease, asthma and pneumonia. Unfortunately, the use of ventilators to support breathing can cause further lung injury, particularly in elderly patients.

Now, a team of researchers at the University of Georgia and Virginia Commonwealth University has developed a computer model to help scientists better understand changes in lung function and respiratory mechanics as people age. They say their work could lead to improved treatment protocols for patients requiring mechanical ventilation. The study, "Aging Effects on Airflow Dynamics and Lung Function in Human Bronchioles," was published yesterday in the journal *PLOS ONE*.

"In general, our dynamic lung function and respiratory mechanics degrade as we grow older," said Ramana Pidaparti, a professor and associate dean for academic programs in UGA's College of Engineering, who served as the study's senior author. "Our study demonstrates and quantifies the effects of aging on airflow dynamics and lung capacity. Understanding these underlying mechanisms can help us develop ways to better treat elderly patients."

Despite the benefits of using mechanical ventilation to assist or replace spontaneous breathing, the therapy can lead to a wide range of complications known collectively as ventilator-induced lung injury, or VILI. These complications include air leaks, oxygen toxicity and structural damage to the lungs. The death rate for elderly patients requiring mechanical ventilation is about 53 percent.

While scientists know that lung function decreases as people age, Pidaparti says it's been difficult for researchers to learn about underlying changes in the mechanical characteristics of lung tissue over time and how those changes are related to VILI.

The UGA and VCU scientists were especially interested in lung compliance, the ability of the lung tissue to absorb applied force resulting from mechanical ventilation. Lungs with low compliance are stiff and require greater pressure to reach a given volume, making

breathing more difficult.

Using MRI and CT scan data, the UGA and VCU scientists created models of a 50-year-old's and an 80-year-old's tracheobronchial tree, bronchioles and alveolar sacs, where aging effects are more pronounced. The researchers performed computational simulations to estimate lung function of the models under mechanical ventilation.

The researchers found lung compliance increased by 41 percent for the 80-year-old as compared to the 50-year-old, suggesting that extra work was required to fill the lungs of an older patient with air. In addition, the simulation showed the elderly are significantly more susceptible to VILI due to changes in the mechanical properties of the lung as measured by pressure, wall shear stress and tissue strain.

The study is part of a larger investigation of lung inflammation and its relationship to ventilator-induced lung injury. The team is examining how the air pressure exerted by mechanical ventilators places stress on lung tissue and how that stress can lead to inflammation and further damage.

They study's authors say the findings are important considerations for the use of mechanical ventilation in elderly patients.

"The ultimate goal of our research is to determine the patient-specific optimal settings for mechanical ventilation airflow that support breathing without harming the patient," said Pidaparti.

More information: JongWon Kim et al. Aging effects on airflow dynamics and lung function in human bronchioles, *PLOS ONE* (2017). DOI: 10.1371/journal.pone.0183654

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