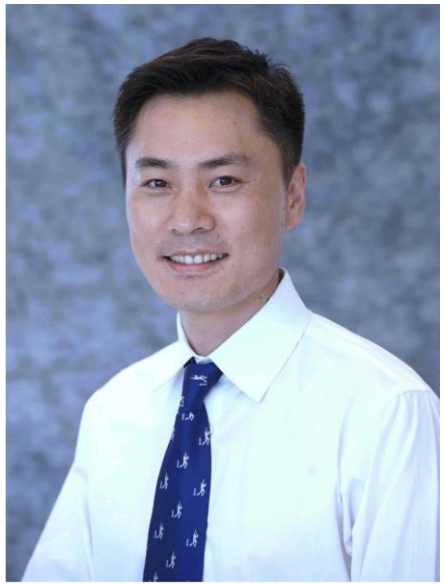
ATS 2020 Highlights

Respiratory Structure and Function Early Career Professionals



Jinho Kim, PhD

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Get to know members of the RSF Assembly

Is your research clinical, basic science or translational?

Translational

Tell us about your research?

The goal of my research is to develop innovative bioengineering methods that can re-establish the structural and functional integrity of donor lungs refused for transplantation due to tissue injury. To achieve this goal, my research team employs a multi-disciplinary approach combining tissue engineering, biomechanics, imaging, and robotics. Our research can contribute to expand the pool of viable donor lungs that are acceptable for transplantation.

Where do you see yourself in 5 years?

Within a few years, I hope my research group can complete establishment of some of the tissue manipulation modalities we have been developing. We will then utilize these methods to demonstrate functional regeneration of injured donor lungs using an animal model. With the newly developed technologies and promising results obtained, our group plan to obtain research grants that can allow us to continue to pursue this important research.

What do you find is the major benefit of RSF Assembly Membership?

The RSF Assembly has been offering me invaluable opportunities to expand my professional network, establish new research collaborations, and improve my scientific competencies through the tremendously supportive, engaging, and inclusive members of the assembly.

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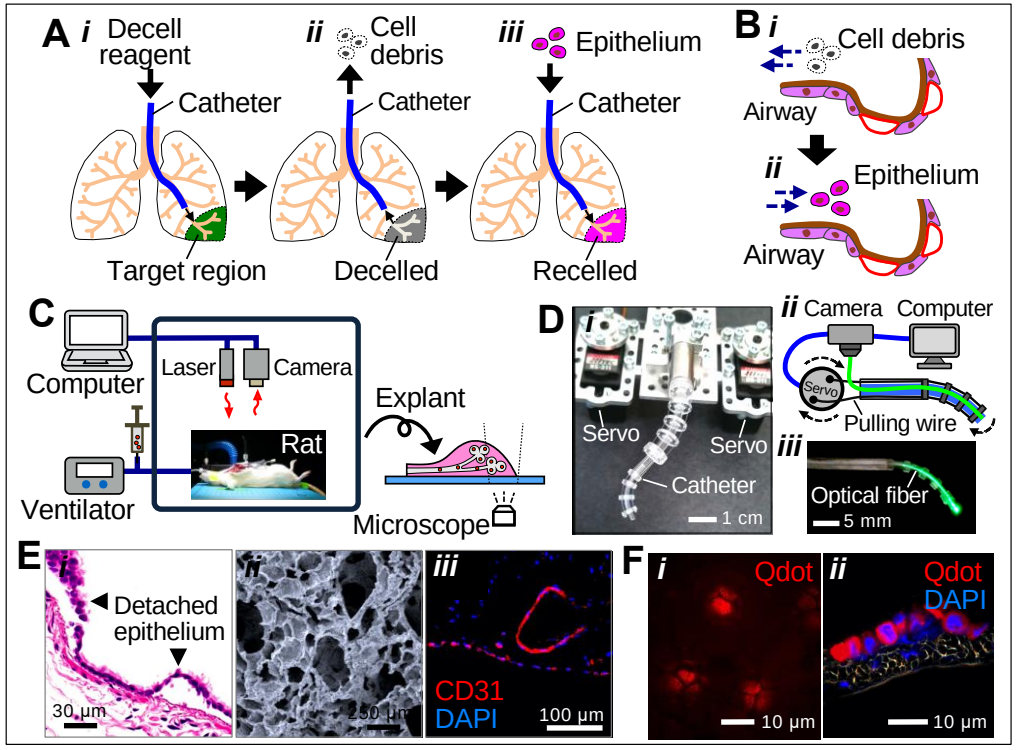

Donor Lung Regeneration via Selective Replacement of Damaged Airway Epithelium

Objective: For patients with end-stage lung disease, lung transplantation is the only therapeutic option available. However, access to transplantation is often constrained by the severe shortage of viable donor lungs. Nearly 80% of donor lungs are rejected for transplant due to diminished lung function caused by damaged airway epithelium. As a result, over 25% of the patients do not receive suitable lungs for more than a year. We develop a cell-based lung regeneration approach where damaged epithelial cells in donated lungs are replaced with healthy cells, improving the overall quality of the lungs.

Methods: To remove damaged airway epithelium, a steerable catheter is placed near a selected region. A small volume of detergents or enzymes is instilled creating a thin liquid layer of decell solution onto the epithelium (Fig. 1A, i). Following incubation, the compromised cells are removed by repeated washing with saline solution (Fig. 1A, ii). The denuded airways are then reseeded with new epithelium by infusion of a liquid bolus carrying the cells, which will generate a cell layer on the airway surface (Fig. 1A, iii). When controlled, the airway epithelium can be gently removed and replaced without damaging underlying lung tissues (Fig. 1B, i-ii).

Results: To monitor cell-replacement processes, we created an imaging system that enabled real-time, non-invasive visualization of reagents and cells within the lung (Fig. 1C). We also constructed an optically guided device for minimally invasive delivery of decell solution and new epithelial cells into selected lung regions. The movement of this device is manipulated through computer-controlled motors that allow gentle insertion of the device into desired locations for removal and replacement of the airway epithelium (Fig. 1D). This approach enables detachment of the epithelial layer from the basement membrane while preserving the underlying lung tissues such as blood vessels (Fig. 1E, i-iii). Also, we demonstrated seeding of cells labelled with red quantum dots (Qdot), onto the airway surfaces via liquid instillation (Fig. 1F, i-ii).

Conclusion: We envision that this novel selective cell-replacement approach could expand the pool of donor lungs that are acceptable for transplantation.

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