Regenerative Medicine Minnesota
Progress Report

Grant Title:	Airway cell and nutrient delivery device for regenerative lung tissue
Grant Number:	RMM-2016-BB-04
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Subaward PI:	Prof. Angela Panoskaltsis-Mortari (University of Minnesota)
Project Timeline:	June 1, 2016– May 30, 2017

Summary of project:

This project took place at the facilities of MSP Corporation (Shoreview, MN) and Mortari Lab (University of MN, Minneapolis). A novel spraying catheter has been developed for efficient stem cell delivery to the airways of decellularized lungs, see Figures 1. As shown in Figure 2, the original device, developed for intratracheal drug delivery, had a viability of about 50% (Group 1), which was improved in two steps to exceed 95%. This sprayer (referred to as Microjet™ Sprayer) is a critical component of the bioreactor system for regenerating a patient's lungs, starting with a lung scaffold created by decellularizing an animal lung comparable in size to the human lung. The regeneration process involves delivery of the patient's own stem cell-derived cells to the vasculature as well as airways of the lung scaffold. Whereas liquid-borne cell delivery is satisfactory for vasculature and small airways, a sprayer device has been needed for coating the walls of the large airways with viable cells, while maintaining lung function. In this project, we have not only developed a sprayer for coating the airway walls, we have also devised means to access the bronchi and other large airways via the trachea. Further, we have developed lighting means to locate the sprayer tip and built mechanical components to facilitate the use of the sprayer in a bioreactor, where lung scaffolds would be recellularized.

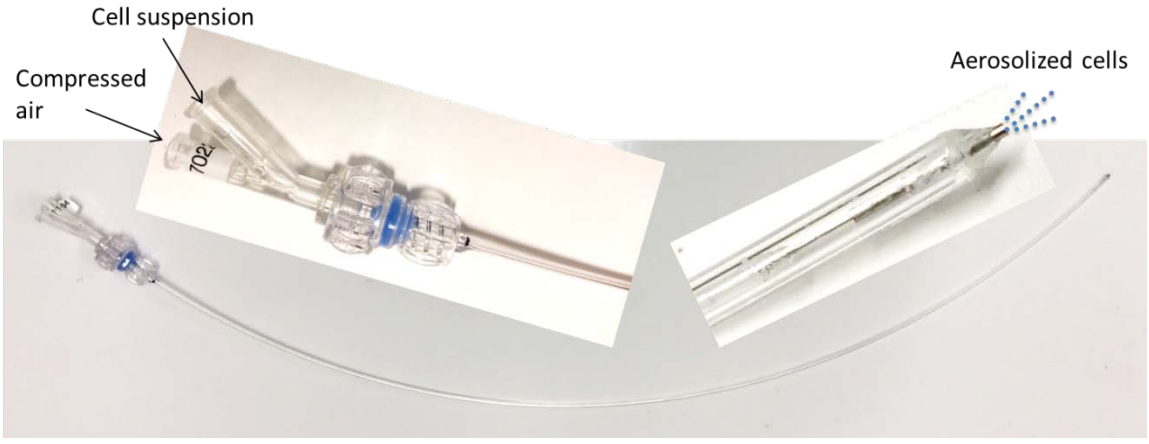

Figure 1: Microjet™ Sprayer optimized for high cell viability and access in decellularized lungs

Cells delivered by the Microjet Sprayer into growth media remain viable after the spraying process, appear grossly normal on microscopy, and divide and grow to confluence without any apparent ill-effects from spraying. Preliminary experiments indicate that cells are able to adhere to the airway surface and express at least one normal cell marker (cytokeratin 5) after being sprayed onto decellularized trachea.

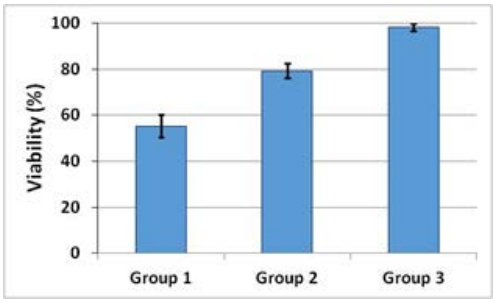

Figure 2: Cell viability results with 3 different generations of Microjet sprayer

This project has helped Minnesota researchers stay at the forefront of the research on regeneration of lung tissue including regeneration of the whole lung using autologous cells for the purpose of lung transplant. RMM award has already enabled preliminary research that has helped Minnesota researchers obtain federal funding from National Institutes of Health to continue the development of a lung bioreactor with the novel feature of including a sprayer device to coat the large airways with cells and nutrients and allow cell differentiation under breathing conditions.