Scientists implant regenerated lung tissue in rats (w/ Video)

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A Yale University-led team of scientists reports that it has achieved an important first step in regenerating fully functional lung tissue that can exchange gas, which is the key role of the lungs. Their paper appears in the June 24 issue of *Science Express.*

Lung disease accounts for around 400,000 deaths each year in the United States. Lung tissue is difficult to regenerate because it does not generally repair or regenerate beyond the microscopic level. The only current way to replace damaged adult lung tissue is to perform lung transplantation, which is highly susceptible to organ rejection and infection and achieves only 10% to 20% survival at 10 years.

The Yale team's goal was to see if it was possible to successfully implant tissue-engineered lungs, cultured in vitro, that could serve the lung's primary function of exchanging oxygen and carbon dioxide. They took adult rat lungs and first removed their existing cellular components, preserving the extracellular matrix and hierarchical branching structures of the airways and vascular system to use later as scaffolds for the growth of new lung cells.

They then cultured a combination of lung-specific cells on the extracellular matrix, using a novel bioreactor designed to mimic some aspects of the fetal lung environment. Under the fetal-like conditions of the bioreactor, the cells repopulated the decellularized matrix with functional lung cells. When implanted into rats for short intervals of time (45-120 minutes), the engineered lungs exchanged oxygen and carbon dioxide similarly to natural lungs.

Lead author Laura Niklason, M.D., Ph.D., professor and vice-chair of the Departments of Anesthesiology and Biomedical Engineering at Yale University and a member of Yale Medical Group, said, "We succeeded in engineering an implantable lung in our rat model that could efficiently exchange oxygen and carbon dioxide, and could oxygenate hemoglobin in the blood. This is an early step in the regeneration of entire lungs for larger animals and, eventually, for humans."

The team found that the mechanical characteristics of the engineered lungs were similar to those of native tissues and, when implanted, were capable of participating in gas exchange. "Seeded and cultured epithelium displays remarkable hierarchical organization within the lung matrix, while seeded endothelial cells efficiently repopulate the lung vasculature, Niklason said.

The Yale team says this is an important first step, but a great deal more research must be done to see if fully functional lungs can be regenerated in vitro, implanted and sustained in their functioning. Niklason says that for this technology to be applicable to patients, it is likely that years of research with adult stem cells will be needed to repopulate lung matrices and produce fully functional lungs.

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Provided by Yale University

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