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Respiratory Support of the Failing Lung: From Respiratory Dialysis to Wearable Artificial Lungs

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Extracorporeal CO2 removal represents an effective treatment strategy for patients with acute and acute-on-chronic respiratory insufficiency. The technology holds the most promise as a means of avoiding intubation and mechanical ventilation in patients with an acute exacerbation of Chronic Obstructive Pulmonary Disease (COPD), and as a means of allowing for lung protective ventilation in patients with Acute Respiratory Distress Syndrome (ARDS). Unlike oxygen supply, carbon dioxide can be removed at therapeutic levels from blood at relatively low extracorporeal blood flowrates, similar to those used in acute hemodialysis. To do so effectively, a novel integrated artificial lung and blood pump system called the Hemolung® Respiratory Assist System (RAS) has recently been developed and commercialized. This talk will introduce the audience to the history of extracorporeal CO2 removal and to the concept of respiratory dialysis, including an overview of current and emergent respiratory dialysis systems. Emphasis will be placed on describing the evolution and current state of respiratory assist devices in the Medical Devices Laboratory at the University of Pittsburgh's McGowan Institute of Regenerative Medicine. The talk will describe the early design and development work leading to the Hemolung RAS, and features which distinguish it from other systems focused on CO2 removal. The challenges of spinning out technology from a university laboratory and commercializing that technology through a startup company, ALung Technologies, will also be reviewed. Key results from recent animal and human clinical trials of the Hemolung RAS will be presented, along with current work on novel enzymatic coatings and other approaches being developed in the laboratory for next generation respiratory dialysis systems as well as wearable artificial lungs.