Prolonged Use of the Hemolung Respiratory Assist System as a Bridge to Redo Lung Transplantation

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Although extracorporeal membrane oxygenation (ECMO) has been used frequently as a bridge to primary lung transplantation, active centers are conservative with this approach in patients requiring redo lung transplantation. We report the use of extracorporeal carbon dioxide removal, using the Hemolung respiratory assist system, as a prolonged bridge to lung transplantation, and the first use of the Hemolung as a bridge to redo lung transplantation. Hemolung support improved the patient’s clinical status and allowed redo lung transplantation. (Ann Thorac Surg 2015;100:2330–3)

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Although extracorporeal membrane oxygenation (ECMO) has been used frequently as a bridge to primary lung transplantation, active centers are conservative with this approach in patients requiring redo lung transplantation because of the technical difficulties of the procedure and risk of severe bleeding adverse events [1, 2]. Mechanical support, including mechanical ventilation (MV), before redo lung transplantation is associated with higher mortality [3]. Here, we describe a case in which prolonged extracorporeal CO₂ removal was performed by use of the Hemolung respiratory assist system (RAS) device (ALung Technologies Inc., Pittsburgh, PA) to improve the patient’s clinical status and allow redo lung transplantation.

We treated a 33-year-old man who underwent a double lung transplantation for cystic fibrosis in 2012. He had an excellent clinical course after his first transplantation, regaining full physical activity. In late 2013, he experienced acute respiratory failure caused by adenovirus pneumonia that led to refractory severe hypercarbic respiratory failure requiring hospitalization, tracheostomy, and prolonged MV (>30 days). After improvement in his clinical condition, including the ability to ambulate with the assistance of a portable mechanical ventilator, he was transferred to our institution because of his high-risk status.

Upon arrival, he was admitted to the intensive care unit (ICU) because of his persistent hypoxemia and hypercarbia requiring MV with high oxygen requirements (up to 100% FiO₂). Despite full MV, he experienced profound hypercarbia (paCO₂ >100 mm Hg) with metabolic encephalopathy and worsening acidosis requiring increasing doses of vasopressors. The patient’s neurologic condition, secondary to high CO₂ retention, prohibited mobilization. He became increasingly difficult to provide ventilation, with dangerously high airway pressures (plateau pressure 55 to 60 cm H₂O) on low tidal volume ventilation.

Because high CO₂ levels were the primary cause of the patient’s hemodynamic instability and the predominant cause of his respiratory failure, and because he was a poor candidate for ECMO support because of his frail clinical condition, volume overload, and need for a redo transplantation, we considered an emergency use of the Hemolung RAS device (approved by our Institutional Review Board) with the intention to improve the patient’s overall clinical, hemodynamic, and neurologic condition and to allow his consideration as a candidate for transplantation. Simultaneously, continuous venovenous
hemodiafiltration was initiated to prevent further fluid overload.

The Hemolung RAS is an integrated respiratory support system that uses a hemodialysis-like circuit to remove CO₂ [4, 5]. The Hemolung consists of a cylindrical bundle of hollow fibers adjacent to a rotating impeller to provide active mixing, which augments gas exchange efficiency and facilitates a compact device design (Fig 1).

Venous blood is withdrawn through a double-lumen catheter (also used for blood return) by a centrifugal pump and flows past the fiber bundle. Sweep gas is drawn through the hollow fibers by a vacuum pump that creates a diffusion gradient for gas exchange across the membrane. This CO₂ removal system differs from ECMO systems in that it is a low-flow system, propelling blood at 500 to 600 mL/min, as compared with typical ECMO flow...