

ECMO as Bridge to Lung Transplant

► Cardiovascular surgeons and lung transplant specialists at Penn Medicine are now using extracorporeal membrane oxygenation (ECMO) as a bridging strategy for individuals with severe end-stage lung disease awaiting lung transplantation. The use of ECMO at Penn in patients with advanced lung disease complements the Penn Lung Rescue Program.

ECMO has been in use for more than 40 years, during which time it has evolved to become an effective option for patients with acute respiratory failure. Advances in technology and technique—low-resistance gas exchange membranes, high-durability centrifugal blood pumps, heparin-coated tubing and improved cannulation strategies have vastly improved the safety of ECMO.

The mechanics of ECMO resemble those of cardiopulmonary bypass (Fig 1). A catheter is placed in a central vein from which blood is drawn through a chamber. Here, carbon dioxide is removed and oxygen infused into the blood cells. The blood is then pumped back into the body at one of two sites—a vein (veno-venous, for pure pulmonary support) or an artery if cardiac support is needed to maintain vital organ function.

Studies suggest that the long-term survival of lung transplant patients who survive a year following ECMO is comparable to that of patients who did not need perioperative ECMO support. Importantly, short-term survival (30-day, 1-year) with the use of ECMO as a bridge to transplantation appears to be improving as a result of better patient selection, better treatment of post-transplant complications and better outcomes at high volume institutions. [1]

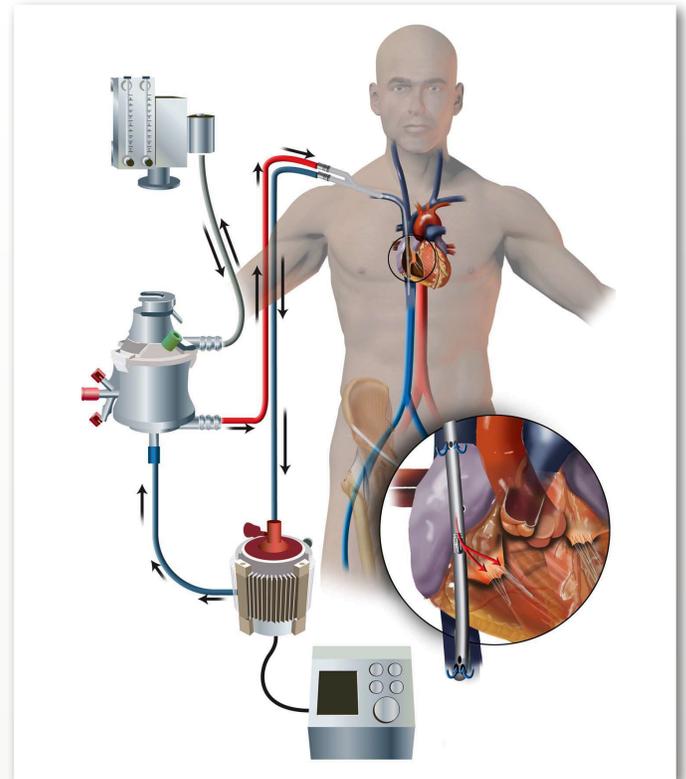
ECMO at Penn Medicine

Over the last year, surgeons at Penn Medicine have successfully bridged more than eight patients to lung transplantation on ECMO support. The objective at Penn is to support the lung function and improve critically ill patients' muscle strength through physical therapy and early ambulation. Ambulatory ECMO can turn the bridge period from a risky waiting time into an opportunity to actively rehabilitate and prevent deconditioning.

CASE STUDY

At age 21, Mr. M had a right radical orchiectomy in November 2014 for non-seminomatous mixed germ cell testicular cancer, stage IIc. His immediate recovery was unremarkable. However, following three months of chemotherapy with bleomycin, etoposide and cisplatin, he developed profound bleomycin lung toxicity rapidly leading to respiratory failure.

Thus, in late March 2015, Mr. M was placed on ECMO support and mechanical ventilation requiring intubation, which was implanted at a hospital near his home. Two months later, while being supported on veno-venous (VV) ECMO, Mr. M underwent small bowel resection with loop ileostomy. Because he couldn't be removed from ECMO, he was then referred to Penn Medicine for lung transplant consideration.



► **Figure 1:** ECMO involves the placement of a catheter in a central vein to draw blood through a chamber where CO₂ is removed and oxygen infused into the blood cells. The blood is then pumped back into the body at either a vein (veno-venous, for pure pulmonary support) or an artery (if cardiac support is needed to maintain vital organ function).

At Penn, he was successfully liberated from mechanical ventilation, but remained on full ECMO support. After extensive evaluation with the solid tumor oncology team, and with the confidence of absence of tumor recurrence, the decision was made to proceed with active listing. Although, Mr. M was a fragile lung transplant candidate, several factors suggested a positive outcome: he was awake, spontaneously breathing and actively performing some physical therapy. In addition, he was able to get out of bed and ambulate with assistance while on ECMO support.

In August 2015, after more than four months of ECMO support, Mr. M received a lung transplant. Subsequently, he was weaned off VV-ECMO, rapidly decannulated, and within one week, liberated from ventilator support. He had no significant post-lung transplant complications. Six months post lung transplant, Mr. M underwent a successful reversal of his previous GI surgery (ileostomy), and now has a substantially improved quality of life.

Reference

1. Hayanga AJ, Aboagye J, Esper S, Shigemura N, Bermudez CA, D'Cunha J, Bhama JK. Extracorporeal membrane oxygenation as a bridge to lung transplantation in the United States: An evolving strategy in the management of rapidly advancing pulmonary disease. *J Thorac Cardiovasc Surg* 2015;149:291-296.

FACULTY TEAM

The renowned cardiologists, cardiac and vascular surgeons and subspecialists at Penn Heart and Vascular employ the most advanced treatment options and therapies available to provide comprehensive, high quality patient-centered care, and with their partners at the Harron Lung Center, offer a comprehensive array of treatments for lung disease, including ECMO as a bridge to lung transplantation.

ECMO for Lung Transplantation Team

Vivek Ahya, MD, MBA

*Medical Director, Lung Transplantation Program
Associate Professor of Medicine*

Christian A. Bermudez, MD

*Surgical Director, Lung Transplantation and ECMO
Associate Professor of Surgery*

Edward Cantu, III, MD

Assistant Professor of Surgery

Jason D. Christie, MD, MS

*Chief, Medical Critical Care Section,
Pulmonary, Allergy and Critical Care Division
Professor of Medicine*

Joshua M. Diamond, MD, MSCE

Assistant Professor of Medicine

Clinical Director

Nancy Blumenthal, DNP, CRNP

Nurse Practitioner

Maria Molina, MSN, CRNP, CCRN

ACCESS

Penn Heart and Vascular Center

Perelman Center for Advanced Medicine

East Pavilion, 2nd Floor
3400 Civic Center Boulevard
Philadelphia, PA 19104

Harron Lung Center

Perelman Center for Advanced Medicine

West Pavilion, 1st Floor
3400 Civic Center Boulevard
Philadelphia, PA 19104