

# Ambulating femoral venoarterial extracorporeal membrane oxygenation bridge to heart-lung transplant



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Chest x-ray. *Left:* before ECMO cannulation. *Middle:* Post-ECMO day 19 and pre-EBHLT. *Right:* Post-EBHLT day 9.

## Central Message

The concept of ambulatory percutaneous VA-ECMO or “walking ECMO” to minimize preoperative deconditioning in a patient awaiting EBHLT.

See Editorial Commentary page e139.

Video clip is available online.

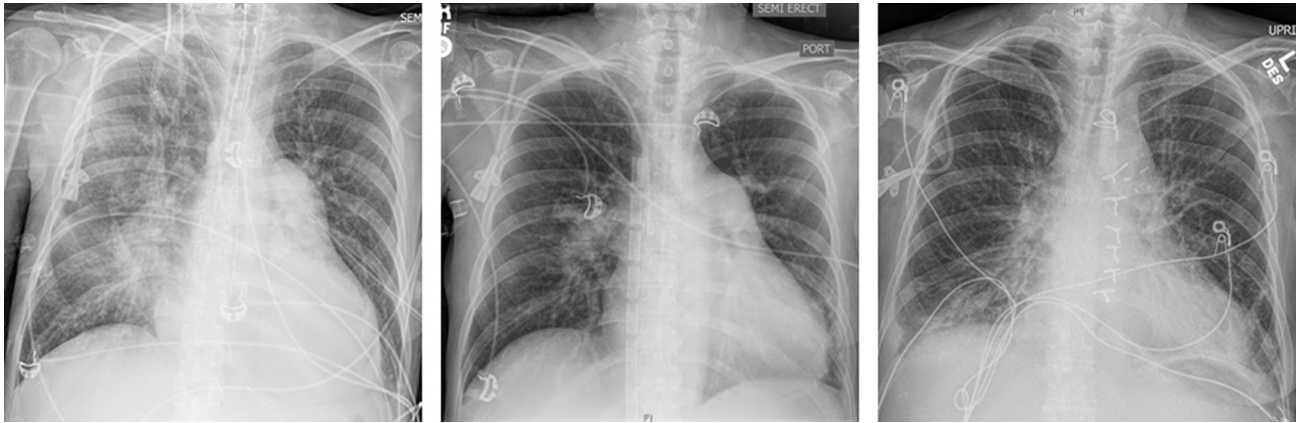
En bloc heart-lung transplantation (EBHLT) represents definitive therapy for end-stage cardiopulmonary failure.<sup>1</sup> However, patients may critically decompensate while awaiting suitable donor organs. In these cases, venoarterial extracorporeal membrane oxygenation (VA-ECMO) may be used as salvage therapy to mitigate end-organ dysfunction and potentially serve as a bridge to transplantation. Although multiple cannulation configurations have been used, femoral access is sometimes most optimal. However, femoral cannulation historically limited mobility, which is of significant concern in patients with preexisting physical deconditioning due to strained physiologic reserve. We present the case of progressive ambulation in a patient with idiopathic pulmonary hypertension (IPH) who was bifemorally cannulated for VA-ECMO while awaiting EBHLT.

## CASE REPORT

A 41-year-old woman, who was listed for EBHLT because of IPH and inotrope-dependent right heart failure, developed hemoptysis and progressive hypoxic respiratory failure that were refractory to escalating ventilatory support (Figure 1, left). Because of the small caliber of her upper-extremity vessels and the desire to avoid sternotomy before transplant, she underwent percutaneous cannulation for VA-ECMO via the right femoral vein and left common femoral artery. Cannulas were securely anchored to the

skin using 4-0 Ethibond sutures at 5-cm intervals, and connections were secured using plastic zip ties.

After extubation on ECMO day 2, focus was directed toward optimizing her physical condition in preparation for the EBHLT. She was placed on a VitalGo tilting bed (VitalGo Systems, Fort Lauderdale, Fla) and participated in daily physical therapy. Initially, she could tolerate 45-degree tilt and 40% weight-bearing for 30 minutes. By ECMO day 9, she could tolerate full tilt and weight-bearing for 30 minutes. After extensive multidisciplinary discussion and planning, the decision was made to attempt ambulation with her bifemoral cannula configuration. The cannulas were re-secured and stabilized using Tegaderm film adhesives (3M Medical, St Paul, Minn) and Velcro straps, and adequate tubing slack was ensured to facilitate lower-extremity movement. With the VitalGo bed in maximum vertical position, the patient was able to step off and ambulate several feet with the multidisciplinary team at bedside. A 2-member perfusion team monitored the ECMO circuit and maintained a pre-primed replacement circuit, the physical therapy team guided her movements, and the bedside nurse and the cardiovascular intensive care unit team closely monitored hemodynamics. ECMO flows were maintained and sweep gas was adjusted to achieve a comfortable respiratory rate with exertion (Video 1). By ECMO day 15, the patient could ambulate for 30 minutes with minimal assistance



**FIGURE 1.** A series of portable chest films showing (*left*) substantial consolidation in the right lower lobe with pulmonary edema before initiation of venoarterial extracorporeal membrane oxygenation; (*middle*) improved aeration and interval decrease in pulmonary edema on post-extracorporeal membrane oxygenation day 19 with cannulas in place; and (*right*) post-en bloc heart-lung transplantation day 9.

and perform strengthening exercises. No complications developed as a consequence of ambulation (**Figure 1, middle**).



**VIDEO 1.** With the VitalGo (VitalGo Systems, Fort Lauderdale, Fla) bed in the maximum vertical position, the patient was able to step off and ambulate several feet with the multidisciplinary team at bedside. The team consisted of perfusionists and physical therapists carefully guiding her movements as she ambulated while the cardiovascular intensive care team closely monitored her hemodynamics. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(18\)30622-6/fulltext](http://www.jtcvsonline.org/article/S0022-5223(18)30622-6/fulltext).

On ECMO day 20, suitable donor organs became available, and the patient underwent EBHLT with an uneventful intraoperative and postoperative course. She was discharged home on postoperative day 12 and has resumed normal physical activity without symptomatic limitations (**Figure 1, right**).

## DISCUSSION

Since 1981, EBHLT has been established as an effective treatment for patients with end-stage cardiopulmonary failure, including those with IPH. When physiologic decompensation occurs while awaiting suitable donor organs, the institution of VA-ECMO may preserve end-organ function and bridge patients to transplantation.

Several institutions have pioneered cannulation configurations that facilitate mobility and prevent prolonged bed-rest. However, these strategies may not be appropriate for all patients and are associated with specific complications, such as ipsilateral upper-extremity hyperperfusion with axillary cannulation.<sup>2</sup> Thus, femoral cannulation may be required. Ambulation with femoral cannulas historically presented difficulties due to concerns for bleeding or cannula dislodgement. However, given the importance of preoperative optimization of physical condition on postoperative outcomes,<sup>3</sup> multidisciplinary mobilization strategies must be developed and used to ambulate patients with this configuration.

A recent study reported the feasibility of standing and ambulating bifemorally cannulated patients without major complications.<sup>4</sup> This present case report describes this feasibility with greater granularity, outlines the multidisciplinary approach and equipment used, and adds to the emerging literature that suggests that femoral cannulation itself would not preclude mobility. This report also highlights the importance of patient selection, because the

patient herself was actively involved in the planning process and maintained a calm demeanor. Also, her size and stature permitted physical therapists to adequately support her in case of complication.

## CONCLUSIONS

With this progressive multidisciplinary ambulation approach, the patient derived the benefits of prehabilitation while awaiting EBHLT. The ability to stand, ambulate, and exercise may have reduced her risk of developing atelectasis and pneumonia, and possibly reduced her risk of postoperative complications.<sup>5</sup> Of note, complications related to mobilization with femoral cannulas in place did not develop in the patient. From this experience, mobilizing and ambulating patients with femoral cannulation are feasible and

safe, and may actually offer benefits with regard to postoperative outcomes.

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