Active rehabilitation with venovenous extracorporeal membrane oxygenation as a bridge to lung transplantation in a pediatric patient

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Background: **Active physical rehabilitation while bridged to lung transplantation with venovenous (VV) extracorporeal membrane oxygenation (ECMO) is an evolving treatment option in adults with limited published experience in pediatric patients.**

Methods: **The administration of VV ECMO through the placement of a single-site bicaval dual-lumen (BCDL) catheter (Avalon Laboratories, Rancho Dominguez, CA, USA) permits respiratory support in a critically ill patient with avoidance of sedation and paralytics while allowing rehabilitation and oral nutrition.**

Results: **A 13-year-old girl with advanced interstitial lung disease underwent active rehabilitation while being bridged to lung transplantation with single-site VV ECMO.**

Conclusions: **The innovative use of single-site VV ECMO with a BCDL catheter is transforming the care of adult patients with advanced lung disease and acute respiratory failure as a method to extend the life of a lung transplantation candidate to maximize all opportunities for organ availability. Based on our experiences, clinicians caring for children should be aware of this potential option in pediatric patients requiring lung transplantation.**

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bridge;
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Case report

Introduction

The development of a bicaval dual-lumen (BCDL) catheter (Avalon Laboratories, Rancho Dominguez, CA, USA) permits respiratory support using venovenous (VV) extracorporeal membrane oxygenation (ECMO) through a single-site catheter.[1] The application of VV ECMO using this single-site approach has become a method to bridge adult patients to lung transplantation while allowing them to be awake for physical therapy.[2-5] Recently, short-term "awake" VV ECMO was described in a small cohort of children bridged to lung transplantation.[6] We report successful active rehabilitation with physical therapy during VV ECMO as a bridge to lung transplantation up to the time of surgery.

Case report

Due to a rapid decline in pulmonary function, a 13-year-old girl with interstitial lung disease required mechanical ventilation. Although she was being referred for consideration of lung transplantation, she had not completed the evaluation process. After 4 weeks of a complicated course in the intensive care unit due to hypercapnea refractory to both conventional and oscillatory mechanical ventilation, a BCDL catheter was subsequently placed in the right internal jugular vein and VV ECMO (PLS Bioline Coating, Quadrox D Oxygenator, Maquet Cardiopulmonary AG, Hirrlingen, Germany) was implemented. A bedside tracheostomy was performed 2 days before the cannulation of the BCDL to improve patient comfort,

Fig. The patient receiving physical therapy for active rehabilitation on venovenous extracorporeal membrane oxygenation.

assist in pulmonary toilet, and permit intermittent ventilation as an anti-atelectasis measure. While on VV ECMO, anticoagulation was performed with heparin in accordance with the Extracorporeal Life Support Organization (ELSO) recommendations[7] with ACT ranging from 180 to 220 seconds.

After starting VV ECMO, sedation was tapered quickly and subsequently stopped with the commencement of active rehabilitation with physical therapy (Fig). The patient completed the transplantation evaluation over the next 5 days and was transplanted 3 weeks later. Using the ELSO criteria for anticoagulation, we found no bleeding complications in the treatment period. During the transplantation, she was maintained on VV ECMO and underwent BCDL decannulation at the end of the transplantation. She was discharged home one month after transplantation.

Discussion

Although single-site VV ECMO is quickly becoming a widely used treatment regimen in adult patients being bridged to lung transplantation,[2-5] there are limited data for its use in the pediatric population. A single report that addresses "awake" VV ECMO as a bridge to lung transplant in children reported successful outcomes in 2 of 3 patients with the patients being extubated for a short period awaiting organ donation.[6] During the period of extubation, intermittent non-invasive mechanical ventilation was provided for respiratory support, but both patients ultimately required re-intubation and sedation before undergoing lung transplantation.[6] In our patient, a tracheostomy was performed and intermittent ventilation was needed while optimizing active rehabilitation until the time of lung transplantation.

Active rehabilitation with physical therapy is feasible and could be safely accomplished in a child bridged to lung transplantation with VV ECMO. This method of care should be considered in children with advanced lung disease and acute respiratory failure who are appropriate candidates for lung transplantation.

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References

1 Bermudez CA, Rocha RV, Sappington PL, Toyoda Y, Murray HN, Boujoukos AJ. Initial experience with single cannulation for venovenous extracorporeal oxygenation in adults. Ann Thorac Surg 2010;90:991-995.
2 Garcia JP, Iacono A, Kon ZN, Griffith BP. Ambulatory extracorporeal membrane oxygenation: a new approach for bridge-to-lung transplantation. J Thorac Cardiovasc Surg 2010;139:e137-139.
3 Mangi AA, Mason DP, Yun JJ, Murthy SC, Pettersson GB. Bridge to lung transplantation using short-term ambulatory extracorporeal membrane oxygenation. J Thorac Cardiovasc Surg 2010;140:713-715.
4 Turner DA, Cheifetz IM, Rehder KJ, Williford WL, Bonadonna D, Banuelos SJ, et al. Active rehabilitation and physical therapy during extracorporeal membrane oxygenation while awaiting lung transplantation: a practical approach. Crit Care Med 2011;39:2593-2598.
5 Hayes D Jr, Kukreja J, Tobias JD, Ballard HO, Hoopes CW. Ambulatory venovenous extracorporeal respiratory support as a bridge for cystic fibrosis patients to emergent lung transplantation. J Cyst Fibros 2012;11:40-45.
6 Schmidt F, Sasse M, Boehne M, Mueller C, Bertram H, Kuehn C, et al. Concept of "awake venovenous extracorporeal membrane oxygenation" in pediatric patients awaiting lung transplantation. Pediatr Transplant 2013;17:224-230.
7 Extracorporeal Life Support Organization Guidelines, 2009. http://www.elso.med.umich.edu/Guidelines.html (accessed June 4, 2013).

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