# ECLS as an "Airbridge" to Advanced Durable Therapies for Heart Failure

Written by Toni Rizzo

Extracorporeal life support (ECLS) may be indicated for patients with refractory cardiogenic shock as a bridge to cardiac transplant or for long-term mechanical circulatory support. In the French territories of the Caribbean, the ECLS is available for emergency cases, but heart transplantation and long-term circulatory assistance are not. Dabor Resiere, MD, University Hospital of Martinique, Martinique, France, discussed the feasibility of transatlantic ECLS-assisted patient transfers.

Venoarterial extracorporeal membrane oxygenation (ECMO) ECLS was used for 68 patients with cardiogenic shock during ST elevation myocardial infarction in Prof. Resiere's center between 2008 and 2014. Intensive care unit survival was 48%, and 6-month survival was 42% [Resiere D et al. SRLF 2013]. The ECMO device can be used to stabilize patients until they can receive a long-term device or transplantation.

ECMO support was used in 12 patients for air transfer to the University Hospital of Martinique from other French Caribbean territories [Lebreton G et al. *Interact Cardiovasc Thorac Surg* 2012]. The average distance was 912 km, with a flying time of 124 minutes. All patients had ECMO implantation and transfer without adverse events. The mean duration of support was 12 days. Eleven patients were weaned from ECMO; 1 underwent heart transplantation; 1 died under ECMO support after 51 days; and 1 died on Day 60 after ECMO removal (Table 1).

Before 2011, commercial airlines did not allow transfer of patients on ECLS support. In 2011, ground and in-flight testing led to an agreement with an airline to transfer patients. Subsequently, Prof. Reseire's group studied the feasibility of transatlantic transport of ECLS-treated patients. This prospective observational study included all patients treated by ECLS and admitted to the general intensive unit or the cardiothoracic surgical department of the University Hospital of Martinique and then transferred to France by plane. Ten patients were transferred on a commercial flight to Paris between September 2011 and February 2014, where they were included on the emergency transplant list. All transfers took place without incident. The outcomes for each patient are shown in Table 2.

ECLS with ECMO is a temporary therapeutic option for refractory cardiogenic shock as a bridge to permanent mechanical circulatory support or heart transplantation. Once ECLS has been initiated, patients require urgent transfer to a specialized center capable of offering

Table 1. Results of ECMO-Assisted Transfer to University Hospital of Martinique

| | **Median (Range)** |
|---|---|
| All ECMO patients, n | 12 |
| Distance of transfer, km | 912 (198-1585) |
| Flying time of transfer, min | 124 (45-255) |
| Aircraft used, n | |
| Puma helicopter | 3 |
| EC 145 helicopter | 2 |
| Learjet | 3 |
| CASA twin-engine transport | 4 |
| Serious events during transfer | 0 |
| Duration of ECMO assist, d | 12 (4-51) |
| ECMO weaning, n | 11 |
| Hospital discharge, n | 10 |
| Veno-arterial ECMO, n | 4 |
| Cardiogenic shock etiology | |
| Myocardial infarction, n | 2 |
| Dilated cardiomyopathy | 1 |
| Severe mitral stenosis | 1 |
| Duration of ECMO assist, days | 6.8 (4-10) |
| ECMO weaning, n | 4 |
| Hospital discharge, n | 3 |
| LVAD implantation, n | 1 |
| Heart transplantation, n | 1 |
| Veno-venous ECMO, n | 8 |
| ARDS etiology | |
| Infectious pneumopathy, n | 4 |
| H1N1, n | 1 |
| Crush syndrome, n | 1 |
| Sickle-cell disease, n | 1 |
| Inhalation, n | 1 |
| Duration of ECMO assist, days | 15 (4–51) |
| ECMO weaning, n | 7 |
| Hospital discharge, n | 6 |

ARDS=acute respiratory distress syndrome; ECMO=extracorporeal membrane oxygenation; LVAD=left ventricular assist device.

Source: Lebreton G et al. *Interact Cardiovasc Thorac Surg* 2012.

Table 2. Outcomes of Patient Transfer to Paris on ECLS

| Age, y | Diagnosis | Outcome |
|---|---|---|
| 41 | DCM | Day 6, Impella; emergency list for transplantation<br>Day 23, died of septic shock |
| 54 | DCM | HeartWare; alive after 3 y |
| 63 | DCM, AMI | Day 4, Impella, ECLS weaning<br>Day 20, died weaning Impella |
| 20 | DCM | IABP, heparin-induced thrombocytopenia, thrombosis in ECLS circuits, died |
| 46 | Massive AMI | Day 6, IABP<br>Day 10, transplantation, alive |
| 45 | DCM | Day 4, IABP<br>Day 10, HeartWare, alive |
| 49 | DCM | Day 6, Impella, emergency list for transplantation, alive |
| 8 | Cardiogenic shock | HeartWare, alive |
| 61 | DCM, AMI | Day 4, Impella, ECLS weaning<br>Day 15, died weaning ECLS |
| 57 | DCM | IABP, emergency list for transplantation |

AMI=acute myocardial infarction; DCM=dilated cardiomyopathy; ECLS=extracorporeal life support; IABP=intra-aortic balloon pump.

destination therapies. In this case series, venoarterial ECMO-assisted transatlantic transport on a commercial flight appeared to be safe without any adverse events during device implantation and transfer and allowed several patients to receive advanced durable treatments for heart failure. As a result, patients living in the Antilles-Guiana region have the option to be transported to France, where they can be listed for emergency heart transplantation or undergo placement of a ventricular assist device.

## Catheter Ablation in AF

Written by Emma Hitt Nichols, PhD

The underlying mechanisms of atrial fibrillation (AF) and its initiation are not well understood, yet catheter ablation can effectively terminate AF in many patients. Ravi Kishore Amancharla, MD, Health City Cayman Islands, Grand Cayman, discussed the benefits of ablation for patients with AF.

There are 2 major competing theories about the mechanism of AF. The "spatially localized" theory suggests that AF is the result of automaticity or localized reentry, whereas the "spatially meandering" theory suggests that AF is the result of multiple-wave reentry. Dr. Amancharla stated that initiation of AF is likely a result of both focal triggers and abnormal substrate.

Catheter ablation of AF focuses on likely focal triggers, and the method used depends on the location. A majority of foci are located within the pulmonary vein [Haissaguerre M et al. *N Engl J Med* 1998], as the muscular sleeve of atrial tissue can be found several centimeters into the adjoining region of the vein. By placing multiple catheters into the pulmonary veins, the location of the trigger can be isolated. However, the triggers may not consistently arise from the same location; therefore, the method changes to ablation of the entire segment of the pulmonary vein. Yet, the muscle sleeve can extend deeper into the atrium, so a large portion of the pulmonary vein is disconnected from the atrium, to lower the risk of recurrence due to better isolation of the pulmonary vein. Despite these improvements, the 5-year recurrence rate at a single center was about 30% following a single procedure (Figure 1). According to Dr. Amancharla, these data suggest that ablation works, but multiple procedures are required for sustained success. The inconsistent results of pulmonary vein isolation may be a result of variable anatomy, inaccurate delineation of the ostium and antrum, the inability to produce an enduring transmural lesion without gaps, and targeting the wrong mechanism. Incorporating newer imaging techniques can help limit these issues, as can the use of a cryoballoon, a circular ablation catheter, and contact force ablation catheters.

In some patients, other mechanisms beyond the pulmonary vein should be considered, particularly in patients who have persistent to permanent disease. The pulmonary vein plays a lesser role as a trigger for disease in persistent and permanent AF [Fisher JD et al. *Pacing and Clin Electrophysiol* 2006]. As a result, the ablation strategy should change. The atrial substrate must be identified via electrophysiologic mechanisms and structure.

For linear lesions, areas of the left atrium are identified to reduce the critical mass, which are required for multiple-wave reentry. Commonly used lines include the perimitral and roof lines [Cabrera JA et al. *Eur Heart J* 2006], which function to compartmentalize the atria into segments that reduce the risk of recurrence.

Targeting complex potentials, as indicated by complex fractionated atrial electrograms (CFEs), is typically used as an adjuvant strategy with pulmonary vein isolation or linear ablation. CFEs are composed of ≥2 deflections or a continuous deflection from baseline of a prolonged activation complex over a 10-second recording. However, Dr. Amancharla commented that the opinion of most